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PLATES.

PLATES

IN THE

TENTH VOLUME, SECOND SERIES.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LV. SECOND SERIES. Dec. 1806.

Specification of the Patent granted to ANDREW FLINT, *late of Gee-street, Goswell-street, but now of Northampton-street, in the County of Middlesex, Millwright; for a Machine, upon an improved Construction, which may be used as a Steam-Engine, and for other Purposes.*

Dated November 16, 1805.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Andrew Flint do hereby declare that my said invention is fully and fairly described in manner following, and in the drawings hereon; and that the various modifications of the same are applicable to many important purposes, as will more fully appear. And, in order to a clear understanding of the said invention in all its parts, it appears requisite that it should be first described as it is to be applied to one purpose only, for example, that of a moving power to be worked by the force of steam, and afterwards to notice such variations or alterations as may be necessary, in order to adapt it to the other purposes to which it may be applicable.

In the drawing hereon, Figs. 1, 2, and 3, (Plate I.) are different sections or views of the internal parts of an engine to be worked by steam; and although this engine may be placed in any required position, either with its central shaft A B in an horizontal, a vertical, or an oblique direction, yet, as I give the preference in most cases to that position of the engine wherein its shaft is placed perpendicularly to the horizon, I shall describe it as such.

Fig. 1, therefore, is a horizontal section through the body of the engine in the line *y z*, Figs. 2 and 3, which are vertical sections of the same in the lines *w x* and *u v* of Fig. 1; the same parts in each figure being marked with the same letter. C is the outer cylinder, of cast-iron or other proper metal. D the bottom plate of the same. E the top plate, firmly fastened down by screws passing through the projecting flanges at *f f f*. G is the inner cylinder, hollow and divided by the partition *h*. The two cylinders C and G must be turned very true, and placed exactly concentrically. A B is the hollow central shaft, cast in one piece with the cylinder G, and forming an axis to it turning in the stuffing boxes I I. K and L are two valves, each consisting of a top and a bottom plate *m m*, (see Fig. 4,) connected by a portion of a solid cylinder *n*. The plates *m* are sunk into the plates D and E so as to lie flush with their inner surfaces; and the connecting piece *n* lies in and fills the cavity prepared for its reception in the outer cylinder C, at *o*, and thus completes the inner surface of the same.

N. B. The valve K, and half of the inner cylinder G, are omitted in Fig. 1, in order to shew the packing grooves, &c. hereafter described. P is the steam-float, firmly attached to the cylinder G, and revolving with it through the circular passage left between the two cylinders; which passage it accurately closes by means of a

packing

packing composed of hemp, tallow, or other substances used in steam-engines for that purpose. *q q q q q* shew the manner of packing the top and bottom plates of the cylinder G, and of the valves K and L, to prevent the escape of the steam between them and the top and bottom plates of the outer cylinder. This is alike in all these instances, but will be most readily understood by comparing Figs. 1 and 3 with Fig. 5, which shews the parts to a larger scale. *r* is a circular groove sunk in the inner surface of the plates D and E, and concentrical to the axis of the cylinder G and of the valves K and L respectively. In this groove is placed a metal packing ring *t*, and it is then to be filled up with a packing, against which the surfaces of the said plates of G, K, and L work; and this packing may be lightened in any degree necessary by the screws *s s s s*, which press upon the back of the packing-ring. It is proper to notice, that these circular rings of packing should in a small degree intersect each other at 1, to prevent the steam from escaping between them into the vacuous part of the engine. 2 2 are chases filled with packing, to prevent a similar escape of the steam behind the valves. The steam-float P is to be packed in its place by means of the circular aperture in the top plate E, at 3, in Figs. 3 and 6; which aperture must be securely closed by a plate fitted into it, and confined by the strong dog 4 and screws 5 5: or the packing may be introduced by holes in the outer cylinder C, which may be closed in a somewhat similar manner; but I consider this mode as less secure when steam of great elasticity is employed. It is evident that if steam of sufficient force be admitted through the hollow shaft A, it will fill the lower division of G, and passing through the hole 6 into the circular passage already described, where (the valve L being first placed across the

said passage) it will act upon the steam-float P with a power proportioned to its elasticity and the area of P, and thus force it round till it passes the valve K, the air or steam before it finding a vent by the hole 7 into the upper division of G, and so through the shaft B into the condenser, &c. If now the valve K be shut, the re-action, as it is termed, will take place against it, and the valve L may be opened to allow free passage to the steam-float. These valves are placed in the required position by the working gear, which may be such as shewn in the drawing Fig. 6, or according to the pleasure of the engineer. It is hardly necessary to observe, that this engine may be worked by what is commonly termed the expansive force of steam, or by condensation in any of the usual modes.

To adapt this invention to be worked by the pressure of a column of water instead of the elastic force of steam, its parts will be nearly resembling those already described. The only precaution necessary is to make the aperture of the shaft A B and of the holes 6 and 7 at least equal to one-third of that of the float P. In this case also less accuracy is required in the packing. By connecting the shaft A with water, or other liquor to be raised, and applying the external force to turn the machine, the water, &c. will be raised by the pressure of the atmosphere into the circular passage before described, whence it will be driven by the motion of the float P in a continued stream through the shaft B into the reservoir.

In this manner also engines for extinguishing fires may be constructed. Blowing-engines also for furnaces and forges may be made on this plan, only observing that the packings should be as perfect as possible.

In witness whereof, &c.

Specification

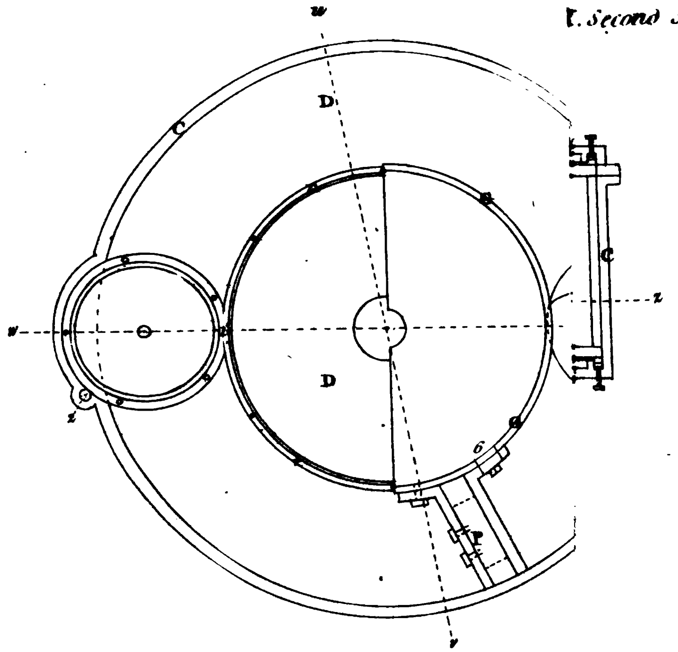
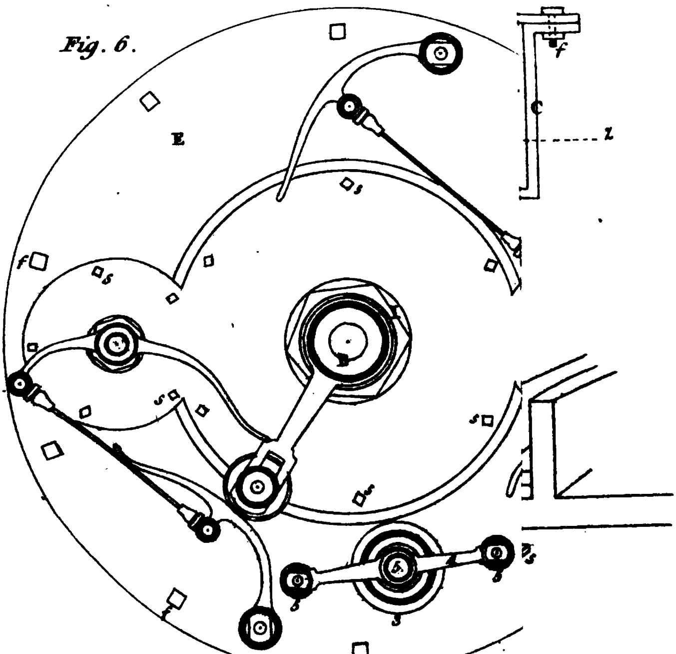


Fig. 6.



Specification of the Patent granted to WILLIAM COOKE, *of Chute-House, in the County of Wilts, Gentleman; for certain Improvements in the Construction of Waggons, and other Carriages which have more than two Wheels.* Dated October 2, 1806.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Cooke do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed, as follows; that is to say: Instead of connecting the wheels with the carriage in the usual manner which confines the lower or bearing parts of all the wheels nearly in one and the same plane, I allow one pair, or more pairs of the wheels to have considerable play or liberty in the axis or axletree of each pair; so that the said axis or axletree, when one of the said wheels shall be either raised or depressed by any obstacle or irregularity, or other cause, may and shall assume various positions out of the level, without requiring or causing the bed of the carriage, or any appendage belonging or fixed to the same, to deviate from the ordinary position of the said bed or appendage, unless such elevation or depression of the said wheel shall exceed the allowed limit of the said quantity of play or liberty; and the manner and means in which, and whereby, I do connect the last-mentioned pair or pairs of wheels with the carriage itself, in order to allow the considerable play or liberty as here described, doth and do consist in the forming or adaption, or addition of a part or parts of the apparatus out or about the place where the axis of such pair or pairs of wheels shall be connected with the carriage, so that the said part or parts

parts may produce or admit of the effect of a hinge or joint, by which the same axis may be allowed to have either of its ends raised or depressed without affecting the carriage within the limits before mentioned; and so that this effect may take place in all the practicable and convenient angles of obliquity formed between the pole and perch and the said axletree in turning or backing, or in any other part of the working of the same.

And I do farther declare, that the mechanical methods or construction of the said parts are easily deducible from the before-mentioned effects and purposes of my said invention, by men of competent skill and experience in works of the nature and kind here described; but that I do in some cases make the upper part or termination of the main pin in the form of a knob or piece of a circular figure. With respect to the central line or axis of the said main pin, (that is to say,) all the sections of the said knob that can be made at right angles to the said axis will be circular, but of a conical or spherical, or other bilging figure, in its longitudinal section, in order that when the said knob shall be placed or inserted within a hollow cylinder of the same diameter as that of its greatest circular section, the said main pin may be at liberty to move sideways out of the direction of the axis of the said cylinder. And I do accordingly place or insert the said knob or upper extremity of the main pin in a cylindrical hole in the bed of the carriage or flying pillow, or other fit part or appendage; taking care, by a nut or other suitable means, to prevent the same from coming out. And the said knob or cylinder do in this construction constitute that part of the connecting apparatus between the carriage itself and the axletree of the pair of wheels to which the main pin belongs, which was herein before described as producing or admitting of the effect

effect of an hinge or joint. And I do suffer the pole or perch, or other part which may be used to support or steady the lower end of the main pin to have a little play to the right and left; and the said main pin to have a limited space for motion up and down in the holes through which it passes. And I do also make the bearing part, which is usually circular, and called the sweeps or hanging pillar or spring bed, somewhat prominent, circular in its or their upright section, so as to be lowest in the middle, and to admit the face of the lower pillow or axle-bed to shift its place of bearing according as the tilt or inclination of the axletree is greater or less; and by all the said contrivances the before-described effect is produced. Or otherwise I make the knob cylindrical, and the hole widening one or both ways from the smallest perforation; or I do make both the knob of the main pin and the hole receiving it bilging or conical in contrary directions. Or otherwise I do place and secure the main pin, or a piece or pieces answering the same purpose of a main pin, in such a manner as not to allow of any side motion or angular change of position in the same with relation to the bed or carriage, and I do connect the pole or perch with the same; and upon or to the said pin or piece or pieces, as an axis, or operating as such, I do fix or apply another piece, which shall be capable of moving round against the sweeps, or in the same manner, by well-known contrivances equivalent to the sweeps. This last-mentioned piece is provided with two pivots or gudgeons, fixed in a line at right angle to the main pin, or through the line or axis about which the said piece may be moved by other gear equivalent to the main pin; which gudgeons are received in sockets attached or fixed to and in a line at right angles to the axis of that pair of wheels which shall or may be intended to have the considerable

siderable play or liberty of motion first herein before mentioned. By this means the axletree is allowed to tilt or move on the said pivots or gudgeons in the manner aforesaid, at the same time that the said axletree is at liberty to be put into any position with regard to the direction of the pole or perch, or carriage itself, will not be tilted or inclined to one side in consequence of the inclination of the said axletree, or of any obstacle or impediment which might have caused it so to incline.

And I do farther declare, that the kind of joint or timbal last described is capable of great variation in its structure by several obvious changes in its dimensions and parts, and their relative situations and action upon each other. Or otherwise, instead of the said pivots or gudgeons, I do make an actual hinge or joint, or socket and bearing pieces, which produce the same effect when interposed and properly secured between the axletree as aforesaid and the piece which was before described as having the same gudgeons or pivots.

And, lastly, that my said invention may be more clearly understood and apprehended, I think fit to observe that the advantages to be gained by my said improvements are not only that the carriage itself is affected in its position by any rise or depression of one of the wheels of any of the pair or pairs herein before alluded to, but also that all the wheels are constantly kept in a state of bearing upon the ground notwithstanding any irregularities of the same; and that the extreme strain of the machinery, and actual danger to which common carriages are exposed, are hereby obviated and avoided.

In witness whereof, &c.

Specification

Specification of the Patent granted to George Wyke, *of Winsley, in the County of Wilts, Esquire; for a Method of working Pumps of various Descriptions by Machinery, whereby much manual Labour will be spared.*

Dated November 19, 1805.

With a Plate.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said George Wyke do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed, as the same is delineated by the drawings in the margin of these presents, as follows; that is to say: In Fig. 1, (Plate II.) I to the letter K, represents the whole of the machinery for working of pumps. A A A part of the chain-pump as now used in ships, which is herein delineated to shew how the machinery acts upon it, one of which is only here inserted, but two or more may be worked or put in motion by the same machinery. B and C a vertical and horizontal wheel, which may be reversed or transposed, as occasion requires, C where B is now placed, and B where C is, in order to accelerate the motion of the pump or pumps which may be found necessary on-board of large ships, or in other situations where a larger power is desired. The ratio of the diameters of the wheels herein described is B four feet and C two feet; but which wheels may be of equal or varied dimensions, as circumstances require. D a shaft or spindle, whose length and dimensions must be, according to situation with the wheel C, fixed to it to work wheel B at the top of

of the shaft. I a small head, to admit the bars or levers F F, or more if necessary. E a stay-collar, to keep the shaft or spindle at a right angle with the wheel C. The shape and size of E will depend upon the requisite strength and situation of the other part of the machinery. F F levers or hand-spikes, about six feet long; but the length and size of which will depend upon the size of the pump, and the situation on which the machinery may be affixed. G deck or platform upon which the force of men is employed at the levers or hand-spikes F F to work the machinery.

Fig. 2 represents a part of other kind of pump-work to which the machinery in Fig. 1 is applicable in raising water, either on-board of ships or vessels at sea, or upon land from wells, pits, ponds, rivers, or in any other situation where the raising and throwing up of water may be required. The levers or hand-spikes F F may be worked or put in motion by cattle, or any other adequate power. Pumps or hydraulic machines of different descriptions to those herein mentioned may be worked by attaching to them, or working them by, the machinery or apparatus as herein describêd, where the situation may be convenient for that purpose.

In witness whereof, &c.

Fig. 1.

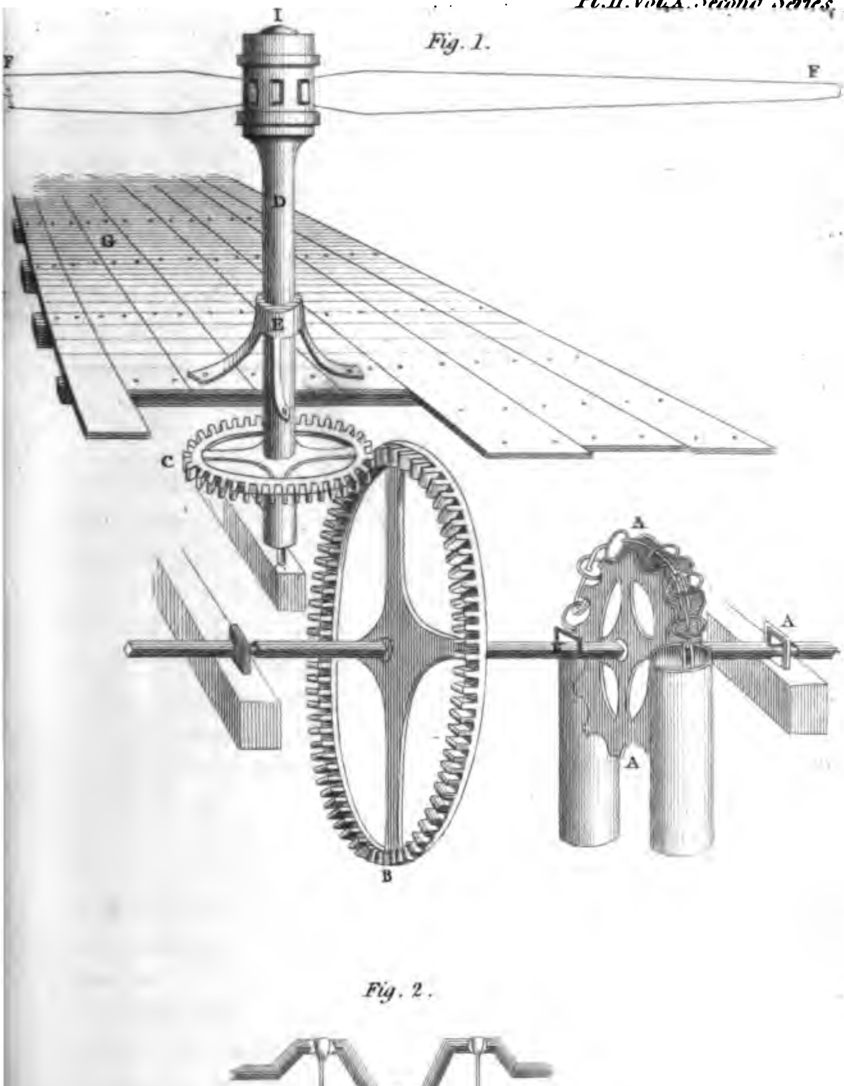
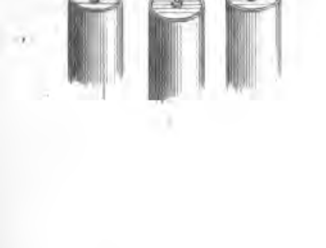


Fig. 2.



Specification of the Patent granted to Isaiah Birt, *of Plymouth Dock, in the County of Devon, Gentleman; for a Black Paint, composed chiefly of earthy and mineral Substances, which will be beneficial to His Majesty's Navy, and the Shipping Interest at large; being particularly calculated to preserve Wood, and prevent Rust in Iron, and may be applied to all the Purposes for which Paint in general is used.*

Dated September 18, 1806.

To all to whom these presents shall come, &c. Now know ye, that I the said Isaiah Birt, in compliance with the said proviso, do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, in manner following; that is to say: My invention consists in uniting, in proper quantities, calcareous or argillaceous earth with lamp-black or ivory-black; and, after the various experiments which I have made to bring it to perfection, I perform my said invention as follows. Take of the blueish marly stone found in copper, tin, and lead mines, (principally in the copper mines,) and of iron stone, and of fine blue marle or slate, and of under-earth, equal quantities, and reduce them, by grinding or pounding, to a very fine powder. To any given quantity of the above-mentioned materials when put together, add one-eighth of their weight of lamp-black, so that there will then be seven-eighths of the earthy or mineral substances, and one-eighth of the lamp-black. This produces my invention of a superior black paint for wood, iron, canvas, or any other thing for which paint is used; but, for the purpose of using such paint, it must be ground (in the usual man-

ner of grinding colours) with oil, as commonly done by colourmen or painters (their boiled oil I much prefer); and the same when mixed with oil, and made up as other paint in general is, may be used with the brush as in common practice. I also perform my said invention by mixing, in equal quantities, any three or any two of the above-mentioned articles of blueish marly stone, iron stone, fine blue marle or slate, and under-earth together, when ground or pounded to powder as aforesaid, and adding thereto one-eighth of their weight of lamp-black as before described. And also I perform it by mixing either one of such articles, when ground or pounded to powder as aforesaid, with one-eighth of its weight of lamp-black as before described. I also perform my said invention by using ivory-black instead of lamp-black; but for general purposes I prefer the lamp-black. Under-earth I have procured from the coal-works in the Forest of Dean, by which name it is well known amongst the colliers there. It is probable that other collieries produce it also. For the blueish marly stone I have not been able to obtain any name; but it is produced in abundance in the mining parts of Devon and Cornwall.

Be it remembered, that my said new invention consists only in the uniting the before-mentioned articles of blueish marly stone, iron stone, fine blue marle or slate, and under-earth, with lamp-black or ivory-black; and that I state one-eighth of lamp-black because that is the quantity I generally use, and which in all the trials I have made has not ever failed to produce the effect; but I have on some occasions used as much as one-fifth, and on others as little as one-sixteenth.

In witness whereof, &c.

Account

Account of various Improvements in Weaving. Invented by Mr. JOHN AUSTIN, *of Glasgow.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was voted by the Society to Mr. AUSTIN *for these Improvements.*

I HAVE for a series of years exerted myself in endeavouring, by means of the following described and other inventions in machinery, and various simplifications and improvements of the same, to render the art of weaving more expeditious and less expensive than it has hitherto proved.

It was not till after much trouble and expense, and reiterated experiments, that I at length succeeded beyond my expectation, in answering the purposes intended; and, having met with approbation from manufacturers of the first respectability, and now that they are actually in practical use by tradesmen who find the advantage of them, I beg leave to submit them to the consideration of the Society, in the conviction, that from the models themselves, the certificates produced, and the character these give to my labours, the Society will be satisfied, upon examination, that they have not been entirely useless; and that they will bestow on them their approbation, and promote their encouragement, by such marks of distinction as they may think they merit.

I do not wish it to be understood, as resulting from my own conviction, when I assert that these inventions and improvements will prove useful; or, that I depend upon certificates

certificates which have been readily granted by individuals; but upon these, joined to the regard paid by the Chamber of Commerce and Manufactures of Glasgow, of which I have had the honour of being a member from its commencement, and from my having above thirty years practice and experience in the manufacture of clear lawns, cambric, and gauze; and as being one of three persons who first attempted the muslin manufacture in Scotland, now so eminent, and from study having acquired an intimate acquaintance with that manufacture through all its stages.

The benefits derived from machinery in a manufacturing and commercial country I need not point out. This country enjoys those benefits to an envied degree; its manufactures are more expeditiously and less expensively sent to market, enriching the state, and rendering the situation of the meanest mechanic more comfortable.

The spotting shuttles save clipping and the waste of spotting yarn to nearly seven-eighths of its whole value; also the pattern is thereby much improved. Fig. A and B (Plate III.) are worked by a single touch of the weaver's finger, although there be one hundred spots in the breadth of the web, and it is done in the same space of time that one of these spots was formerly worked by the weaver, who usually kept a boy on each side of him, each working spot after spot with his fingers; these spots are called brocaded, or finger spots. Fig. G H goes obliquely through the shed of the web, and will make any figure of a spot on a plain or twilled mounted web, without spotting hiddles or treadles. Fig. E F will answer with pressers to keep down the yarn that is not in the spot, without spotting hiddles or treadles, and other mounting formerly necessary.

The

The first was invented by me, and communicated by me to Archibald Mac-Vicar, who worked at such things for me, and who reduced it to the form C D.

The Fig. E F are improvements on these not yet in common practice.

Fig. K and L is an universal ravel or sniffle, useful at the beaming of all kinds of webs. This machine is of itself complete, and will beam from the coarsest to the finest web, and to any breadth required; whereas, by those in common use, one hundred and twenty different ones are necessary, the value of which is above 120l., and the whole not so complete as one of mine, the expence of which does not amount to above the price of two of the medium value of the common kind; namely, thirty shillings, which the machine-maker who made the first of them supplies them at. Country weavers are often at a great loss for the particular set or kind they want of the old kinds, and have to send many miles to procure one. In manufacturing towns weavers have joint sets of them, although few complete ones, and hire them to those who want them; whereas on my plan every weaver may have one.

I have also sent to the Society specimens of types or figures, formed of burnt clay or porcelain, for printing patterns upon calicoes, or designs for articles to be sewed or tamboured. These types are not liable to be destroyed by fire, nor by lying in a damp place. They may be made to a certain depth, so as to be varied at pleasure to the taste or fancy, the same as letter-press printing types. A certain number may be marked on each type, to ascertain the exact proportion of the price of tambouring or sewing, the rates of the same work being frequently very irregular for want of a regular standard to calculate them by.

They

They may be purchased at half, or even one-fourth of those cut in wood; they are equally durable, or more so, and may be made finer than any cut in wood.

REFERENCE TO MR. AUSTIN'S INVENTIONS.

Fig. A. Plate III. shews the machine or shuttle, for brocading or forming Jamdanna spots, or other designs on muslin, lawn, cambric, silk, or other fancy goods, instead of using one spotting shuttle, and afterwards cutting away the yarn to loss, between the spots or figures, as formerly done between every shoot or cast of the shuttle. It is a frame of brass so long as the breadth of the web, the wheels of the size and at the distance required for each spot in the breadth of the web at equal distances. The knob or button of the teethed rack *a* being pushed backwards or forwards until the wheel *b* makes a full revolution with the pirn or bobbin shewn at Fig. J, which is affixed to the wheel *b* in Fig. A, and which coming round under the warp-yarn raised for the spot, brings the yarn of which the spot is wove from the one side of the spot to the other: *c* in Fig. I, is a spring made of quill, steel, or brass, to prevent the spotting yarn coming off too quick, which spring, when the pirn is full, presses hard upon the yarn, and gives less pressure as it empties.

Fig. B is another view of the machine A, with the wheel *b*, half turned round, which turns upon a large centre, part of which centre is cut off as represented; and when the communicating wheel *a* is opposite to the vacant part of the wheel *b*, the other wheel *c* turns it round, until a whole revolution is made alternately, and until the design or spot is finished.

Fig. C is another invention for the same purpose, and worked in the same manner with less machinery; there being only three teeth, or round pins in the pinion, which

are

are driven by the rack or slider *a* with deep-cut teeth, as represented in the Engraving.

Fig. D is another view of the last, with the wheel *b* turned half round.

Fig. E and F shew a third invention for the same purpose: by touching the knob *a*, the slide *b* goes backward and forward, and carries the arch *c* along with it, the two points of which come between the two points *a* and *b* of Fig. I, which is a small brass shuttle, of which there is one for every spot in the breadth of the web; it carries the spotting yarn through under the warp threads raised about *an inch only*, in place of three inches or more, formerly done for a single shuttle to the whole spots in the breadth of the web.

In Fig. I, *c* is the spring above described; *d* is a standard and hole through it answering to the eye of the common shuttle, through which the yarn runs.

In Fig. F, *a* is a plate of brass, which, as the slide and arch go along, takes against the inside of the arch, and raises and keeps up that end of the arch; but before that end loses its hold of the shuttle, the other end of the arch is between the other two points *a* and *b* of the shuttle Fig. I, at the contrary side of the warp yarn raised for the spot, so that the shuttle is never loose, nor can it go out of its proper place, being also confined above and below by two grooves *b* and *c*, Fig. F.

In place of spot treadles to raise the warp of the spot, this may be done by pressers, to slide to any distance from the centre, and to keep down such part of the warp as is *not* to be in the spot.

Fig. G and H shew a fourth method of making spots or figures, and will form any shape or pattern without raising the warp yarn, or having any pressers for that purpose. It consists of a jointed frame, as represented, partly above

 and

and partly below the web, which comes through the space *a*, Fig. G; and by moving the frame from the angle of Fig. G to the angle of Fig. H, or to any other angle between them, and while the upper and under shade or half of the warp is open, you let down or raise up the shuttles, which going through the upper and under shade, according to the angle given, will pass through the upper and under shade at different splits or spaces of the reed, and leave the spotting yarn as required in such part of the shade of any web, twilled, striped, checked, or plain.

The frames of the machines, Fig. A, B, C, D, E, F, are set into two sliders at an angle of about seventy degrees, immediately from before and close to the reed to abovethe weaver's head, with cords, pullies, and weights, to overbalance and raise them in this direction six to eight inches, and are taken down by the foot with a treadle or pedal, cross, shaft, pullies, and cords.

Fig. G and H may be attached to the batten lay, or swinging frame and reed, or run on casters horizontally backwards and forwards.

Fig. K and L will shew a very simple method of beaming webs of any number of half gangs, goes, runners, or equal quantities of warps or chains of yarn, putting each division of the warp into each tooth or division of the ravel, snifffle, heck, rake, or frame, for regularly placing the chain or warp of a web on the beam; which when done, all that is necessary is to contract or expand the frame to the breadth of the web required, without paying any regard to the quantity or quality, which in the old way puzzles many good weavers, to calculate and to find one that will suit, as there are about one hundred and twenty different sets or scores, and quarter-scores of the kinds which are made and used as necessary for the purpose, and after all not exact.

Certificates

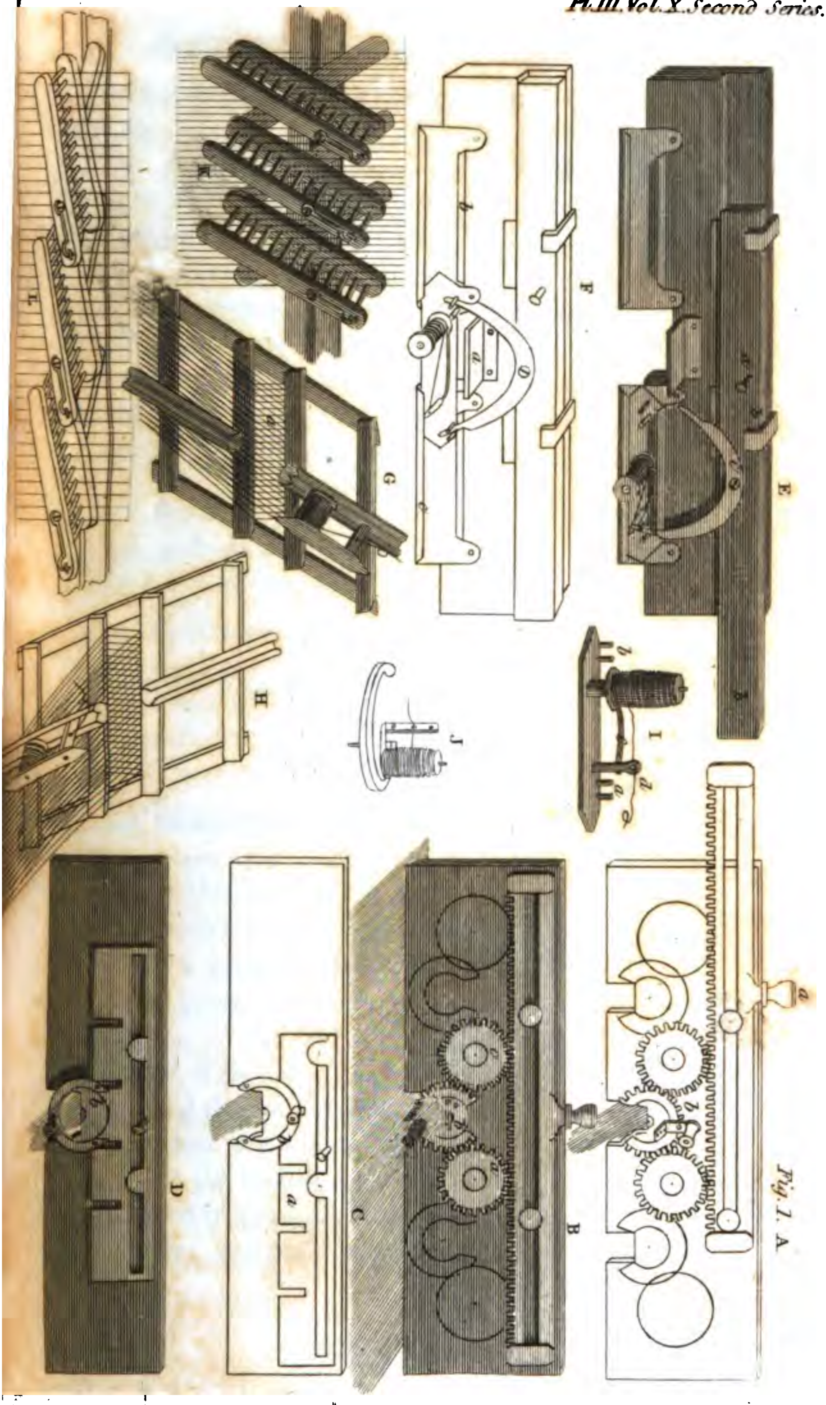


Fig. 1. A
B
C
D
E
F
G
H
I
J
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Certificates in favour of Mr. Austin's Ravel were received, from Mr. William Jameson, jun. Mr. Andrew Stephenson, Mr. Alexander Pollock, and Mr. William Miller; in favour of his printing types, from Messrs. J. and J. Scott, Mr. Louis Ruffini, Mr. Alexander Patrick, and Mr. John Kirkland, all of Glasgow; and in recommendation of his mode of spotting or brocading muslins in the loom, and his other inventions, from the Directors of the Chamber of Commerce and Manufactures held at Glasgow, June 12, 1804.

A third Series of Experiments on an artificial Substance, which possesses the principal characteristic Properties of Tannin; with some Remarks on Coal.

By CHARLES HATCHETT, *Esq. F. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

§ I.

IN my former Papers upon this subject, some account has been given of the effects produced by sulphuric acid upon turpentine, resin, and camphor; and I shall now state the results of other experiments made with the same acid upon a great number of the resins, balsams, gum resins, and gums, the greater part of which afforded that modification of the artificial tanning substance, which, for the sake of distinction, I have in the preceding papers denominated the third variety.

The process was simple digestion in sulphuric acid, after which the residuum was well edulcorated, and was then digested in alcohol. This was separated by distillation, the dry substance which remained was infused in

 cold

cold distilled water, and the portion dissolved was examined by solution of isinglass, muriate of tin, acetite of lead, and sulphate of iron.

Much sulphureous acid, carbonic acid, several of the vegetable acids, particularly benzoic acid, (when the balsams were employed,) and apparently water, were produced during the operation; but in this Paper I shall only notice two of the products, namely, the tanning substance and the coal.

The sulphuric acid almost immediately dissolved the resins, and formed transparent brown solutions, which progressively became black.

The same effect was produced on most of the other substances; but the solutions of the balsams and of guaiacum were at first of a deep crimson, slightly inclining to brown.

Caoutchouc and elastic bitumen were not dissolved, but after having been digested for more than two months, were only superficially carbonized.

The gums and the saccharine substances required many evaporations aud filtrations before the whole of their carbonaceous residua could be obtained.

These were the principal effects observed during the experiments, and I have stated them in this manner, that tedious and useless repetitions may be avoided.

§ II.

Turpentine, common resin, elimi, tacamahac, mastich, copaiba, copal, camphor, benzoin, balsam of Tolu, balsam of Peru, asa fœtida, and amber, yielded an abundance of the tanning substance.

Oil of turpentine also afforded much of it; asphaltum yielded a small portion; some slight traces of it were even obtained from gum arabic and tragacanth; but none was produced

produced by guaiacum, dragon's blood, myrrh, gum ammoniac, olibanum, gamboge, caoutchouc, elastic bitumen, liquorice, and manna. I am persuaded, however, that many of these would have afforded the tanning substance, had not the digestion been of too long a duration.

Olive oil was partly converted into the above-mentioned substance, and also linseed oil, wax, and animal fat; but the three last appear to merit some attention.

Linseed Oil.

This oil with sulphuric acid very soon formed a thick blackish-brown liquid, which after being long digested in a sand-bath, was still partly soluble in cold water, and passed the filter. This solution precipitated gelatine; the residuum was a tough black substance, which became hard on exposure to air. A great part was soluble in alcohol, and formed a brown liquid, which became turbid by the addition of water. When this was evaporated, a brown substance remained, which was partially dissolved by cold water, and the solution thus formed was rendered turbid by gelatine.

The undissolved portion left by the alcohol was of a blackish-blown: it was soft and tenacious, and appeared to retain many of the properties of an inspissated fat oil.

Bleached Wax.

That which was employed in this experiment was the white wax of the shops, which is sold in the form of small round cakes. It formed with sulphuric acid a thick black magma, and was not acted upon by cold distilled water when washed with it upon a filter. Upon being digested with alcohol in a sand-bath, a brownish solution was formed, which upon cooling became very turbid, and appeared as if filled with a white flocculent substance. The same operation was repeated with different portions

of

of alcohol until this ceased to act. The whole of the solutions in alcohol were then mixed, a large quantity of distilled water was added, and the alcohol was separated by distillation.

On the surface of the remaining liquor, when cold, a white crust was formed, which being separated, was found to possess the properties of spermaceti, and weighed 18 grains. The filtrated liquor was then evaporated to a small quantity, became of a pale brown colour, and was rendered turbid by solution of isinglass.

Animal Fat.

This experiment was made upon the kidney fat of veal, but I cannot take upon me to assert that the results would have been the same with every kind of fat. 100 grains of it with one ounce of concentrated sulphuric acid, after some time formed a blackish soft mass; a second ounce of sulphuric acid was then added, and the whole was digested and occasionally heated during nearly three months. Six ounces of distilled water were poured upon the black pulpy mass, and formed a thick uniform liquid, which, after digestion for six or seven days, was when cold filtrated, The liquor which passed was of a brown colour, and upon evaporation became black, leaving a considerable portion of a blackish substance upon the filter, which was added to that which had been collected by the first filtration. The whole was washed with cold water, which passed colourless. Boiling water was then poured upon the filter, by which a considerable portion was rapidly dissolved, and a brownish-black solution was formed, which copiously precipitated gelatine.

The residuum on the filter was then dried, and being collected, was digested in alcohol, which dissolved the greater part.

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The solution in alcohol was filtrated, but (apparently by the effect of air) a considerable deposit was formed on the filter, which was again dissolved by alcohol. Water rendered the solution turbid, and a black light flaky substance, which weighed 41 grains, remained upon the filter. The filtrated liquor was then evaporated, and left a grayish-black substance, which weighed 30 grains. This last substance was highly inflammable, and when burned emitted a very peculiar odour, resembling partly that of fat and partly that of asphaltum. It easily melted, and also immediately dissolved in cold alcohol, from which, like the resinous substances, it was precipitated by water.

The black light flaky residuum, which weighed 41 grains, was found to consist partly of the substance above mentioned and partly of coal, but the proportion of this last was not ascertained.

Coagulated albumen and prepared muscular fibre were also separately exposed to the action of sulphuric acid in the manner above described, but did not afford any substance by which gelatine could be precipitated, coal being the only product which remained.

Almost every one of the bodies which have been employed in these experiments seem to be in some measure different in respect to the progressive effects produced upon them by sulphuric acid; and all other circumstances being similar, there appears to be a certain period of the process when the production of the tanning substance has arrived at its maximum, after which a gradual diminution of it takes place, and at length total destruction. These effects are produced at different periods, according to the substance which may be the subject of the experiment; and therefore it is impossible at present to state the utmost quantity of the tanning substance which,

which, under equal circumstances, may be obtained from each of the resins, balsams, &c.

The tanning substance appears to be always the same, whether obtained from turpentine, or common resin, or from the balsams, or from asa fœtida, or camphor, or indeed from any of the bodies which have been enumerated; its effects on the different re-agents are similar; by the addition of a small portion of nitric acid, and subsequent evaporation, it is converted into that which I have called the first variety; or if digested with sulphuric acid, it is speedily destroyed, and becomes mere coal. In the latter case, therefore, the same agent which at first produced it becomes at length the cause of its destruction; and thus we find, that although a tanning substance may be obtained from resinous and other bodies by means of sulphuric and by nitric acid, yet in the former case the product is variable, and is formed at or about the mean period of the operation, whilst the latter is an ultimate and invariable effect, beyond which no apparent change can be produced by any continuation of the process *.

§ III.

I have already stated, that caoutchouc and elastic bitumen were only superficially acted upon when digested for a very long time in sulphuric acid; and it is remarkable that these substances, which in their external characters so much resemble each other, should be similar in their habits when exposed to the effects of this acid; for, unlike the resins and most of the other bodies which were subjected to the preceding experiments, and which were almost immediately dissolved when the acid was poured

* In the former Papers upon this subject I have observed, that the tanning substance produced by sulphuric acid is very inferior in energy to that which is formed by nitric acid.

upon

upon them, these on the contrary remained undissolved, and only became partially carbonized on their surfaces. Even nitric acid does not so rapidly effect a change in the elastic bitumen as it does when applied to the other bituminous substances.

1. 100 grains of pure soft elastic bitumen were digested during three weeks in one ounce of nitric acid, diluted with an equal quantity of water; a tough and slightly elastic orange-coloured mass then remained. Another ounce of the acid, not diluted, was poured upon this mass, and the digestion was continued until the whole was evaporated. The residuum was tenacious, and of the colour above mentioned. Water partially dissolved it, and formed a deep yellow liquid, which copiously precipitated gelatine, and possessed the other properties of the tanning substance which is produced from the resins, &c. by nitric acid.

An orange-coloured mass still remained, which was speedily dissolved by alcohol, and was precipitated from it by a large addition of water.

This substance in many of its properties resembled the resins, but in others seemed to approach those which characterize the vegetable extractive matter. It appeared to be similar to that which has been cursorily mentioned in my first Paper, and which was obtained from many of the pit-coals and bitumens when treated with nitric acid. I have since paid more attention to this substance during the following experiments:

Kilkenny coal was digested with nitric acid, and progressively, although with difficulty, was converted into that variety of the tanning substance which has so often been mentioned. Similar experiments were made on the same sort of coal from Wales, which was given to me by my friend Mr. Tennant, as well as upon a coal sent to

me by Professor Woodhouse, which was from Pensylvania, and is there called Leigh high coal. All of these were converted into the tanning substance, but they did not yield any product similar to that obtained from the elastic bitumen.

The contrary, however, happened when the common pit-coal, or Cannel coal, or asphaltum, were employed. For when these were treated in the way which has been described, and when the digestion was not too long continued, then I obtained from 100 grains of each of the above substances (after the separation of the tanning matter) a residuum as follows:

	Grains.
From 100 grains of the common Newcastle coal	9
From 100 grains of Cannel coal - - - - - -	36
From 100 grains of pure asphaltum - - - -	37

The substances thus obtained, were very similar in their external characters, being of a pale brown, approaching to Spanish snuff colour; their internal fracture was dark brown, with a considerable degree of resinous lustre. When exposed to heat they did not easily melt, but as soon as inflamed they emitted a resinous odour mixed with that of fat oil, and produced a very light coal, much exceeding the bulk of the original substance.

Alcohol completely dissolved them, and if water in a large proportion was added to a saturated solution, a precipitate was obtained, but after each precipitation a portion always remained dissolved by the water, which acted upon the different re-agents in a manner similar to the solutions of vegetable extractive matter. The flavour was also bitter, and in some degree aromatic, so that the residua, whether obtained from pit-coal, from Cannel coal, or from asphaltum, seemed to possess properties intermediate between those of resin and those of the vegetable

table extractive substance. They appeared, however, to be removed only by a very few degrees from the tanning substance; for, if digested in a small quantity of nitric acid, and subsequently evaporated, they were immediately converted into it; or if digested with sulphuric acid, they speedily became reduced to coal.

§ IV.

In the fifth section of my second Paper, some remarks were made on the decoctions obtained from vegetable substances which had been previously roasted; and although (excepting one instance) these decoctions did not afford any permanent precipitate with gelatine, yet I have there stated, that I did not think it right to conclude, that similar decoctions, made under certain circumstances, might not occasionally possess those properties which characterize the tanning substances. Moreover, I also observed in the same Paper, that all of those decoctions, upon the addition of a small portion of nitric acid and subsequent evaporation, became converted into that variety of tanning matter which is produced by the action of nitric acid upon carbonaceous substances. I have since extended these experiments, and shall here give some account of them.

1. 200 grains of the fresh peels of horse-chesnuts were digested for about twelve hours in three ounces of distilled water. The liquor was of a pale brown, and formed a slight pale brown precipitate when solution of isinglass was added to it.

2. 200 grains of the same peels were moderately roasted, and being afterwards digested with three ounces of water, formed a dark brown decoction, which was not rendered turbid by gelatine.

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3. The above-mentioned roasted peels, after the termination of the preceding experiment, were added to the remainder of the filtrated liquor. A quarter of an ounce of nitric acid was poured upon the whole, which was then digested and evaporated to dryness. The mass was afterwards infused in water, and a dark reddish-brown liquid was obtained, which copiously precipitated solution of isinglass.

4. 200 grains of horse-chesnuts, from which the peels employed in the former experiments had been taken, were bruised, and were digested with three ounces of water. The liquor was turbid, and of a pale red colour. It was filtrated, and some solution of isinglass was added, but without any effect.

5. 200 grains of the same horse-chesnuts were moderately roasted, and being treated as above described with water, yielded a dark brown decoction which was not rendered turbid by isinglass.

6. The horse-chesnuts, which had been employed in the preceding experiment with the remaining liquor, were digested with a quarter of an ounce of nitric acid until the whole was become dry. Water was then poured upon it, was digested, and a dark brown liquid was formed, which afforded a considerable precipitate by the addition of solution of isinglass.

From these experiments it appears, that the small portion of tannin which the horse-chesnut peels originally contained, was destroyed by the process of roasting; that the brown decoction subsequently obtained from the roasted peels and from the horse-chesnuts, did not act upon gelatine; but that these were speedily converted into the artificial tanning substance, by the addition of a small portion of nitric acid and subsequent evaporation.

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The first preparations of the artificial tanning substance which have been mentioned in the former Papers, were made from coal of different descriptions digested with nitric acid; and as similar products have been obtained by the same acid from various decoctions of roasted vegetable substances, there cannot be any doubt, that vegetable bodies when roasted, yield solutions by digestion in water, which essentially consist of carbon approaching to the state of coal, although not absolutely converted into it, for if so, all solubility in water would cease.

But coal is apparently nothing more than carbon oxydized to a certain degree, and may be formed by the humid as well as by the dry way.

Examples have been already stated respecting operations in which sulphuric acid has produced this effect, but the same likewise appears to be produced with some modifications, whenever vegetable matter undergoes the putrefactive process; for, when this takes place, as in dunghills, &c. a large proportion of the carbon of the original vegetable substances appears to be combined with oxygen sufficient to communicate to it many of the properties of coal, whilst the compound nevertheless is capable of being dissolved by water with the most perfect facility.

It must not, however, be understood that by this process all the other elementary principles are separated, so that only the carbon remains combined with oxygen, but merely that the other principles are so far diminished that these, namely, carbon and oxygen, predominate in a state approaching to coal, although soluble in water.

Such solutions, I have every reason to believe, are nearly similar to those afforded by vegetable substances which have been previously roasted; and although I have examined but a few of them, yet I shall relate some

experiments

experiments which I have lately made on the peels of walnuts.

It is well known that when these are kept in small heaps for a short time they become soft, and break down into a black mass, which affords a brownish-black liquor. On these I therefore made the following experiments:

1. About one ounce of walnut peels, which were become soft and black, was digested in water.

A dark brown liquor was thus formed, and being filtrated, was examined by a solution of isinglass, but not any apparent effect was produced.

2. On an equal quantity of the walnut peels, in the same soft black state, a small portion of nitric acid was poured, and after being digested for about five hours, the whole was evaporated to dryness. The residuum was of a brownish orange colour, and yielded a similar coloured solution to water when digested with it. This was filtrated, and upon the addition of solution of isinglass, became turbid, and deposited a tough precipitate, which was not dissolved by boiling water.

3. Another portion of the walnut peels was moderately roasted, and was then digested in water; the brown solution was filtrated, and formed a slight precipitate with gelatine.

4. On the residuum of the last experiment, a small quantity of nitric acid was poured, some water was then added, the whole was digested during about five hours, and until it became perfectly dry.

Water formed with this a brown liquor, which yielded a very abundant precipitate by the addition of dissolved isinglass.

Upon these experiments we may remark, that the solution in the first instance containd carbon in a state approaching to coal, for when treated with nitric acid in the second experiment, a portion (although small) was produced

duced of the same tanning substance which is formed from the different kinds of coal by nitric acid.

The third experiment appears to shew, that a small quantity of a substance approaching to tannin was produced by the simple process of roasting: and the fourth experiment corroborates those already described, in which, the artificial tanning matter was copiously produced, whenever roasted vegetable substances, were treated with nitric acid.

In respect to vegetable substances, especially those which contain tannin, I shall here relate a few other experiments.

It has been remarked in my second Paper*, that the tannin of galls was immediately destroyed by nitric acid. Since that time I have made the following additional experiments:

1. 100 grains of galls reduced to powder were infused with four ounces of water, and part of the infusion upon the addition of solution of isinglass afforded (as usual) a copious precipitate of a brownish-white colour.

A quarter of an ounce of nitric acid was added to one ounce of the above infusion, which then was not in any manner affected by the dissolved isinglass.

2. 100 grains of the same galls were slightly roasted, and being digested with four ounces of water, formed a brown liquor, which was filtrated.

Solution of isinglass was then added to a part of the above liquor, and produced a precipitate not very unlike the former, but much less in quantity.

After this, a quarter of an ounce of nitric acid was added to one ounce of the same liquor, and some dissolved isinglass was subsequently poured into it, by which it was

* Inserted in the eighth volume of the present series of this work.

rendered

rendered turbid, and a small portion of a dark brown precipitate was produced, resembling that which is commonly afforded by the artificial tanning substance.

3. The remainder of the above-mentioned liquor, with the residuum of the roasted galls, were digested with a quarter of an ounce of nitric acid until the whole had become dry. Water was then poured upon it, and formed a dark brown solution, which yielded a copious brown precipitate by the addition of dissolved isinglass.

From these experiments on galls it appears, that the natural tannin contained in them is destroyed by nitric acid; that the tannin is also diminished, and, I may add, is ultimately destroyed by the process of roasting; that when galls have not been so far roasted as to destroy the whole of the tannin, then the remainder of this seems to be destroyed by the addition of nitric acid, whilst at the same time a small portion of the artificial tanning substance is produced; and that this last is always plentifully afforded by roasted galls when digested with nitric acid, similar to other vegetable bodies when thus treated.

These remarks are also partly confirmed by the following experiments upon oak bark.

1. 200 grains of oak bark, reduced into very small fragments, were infused in about four ounces of water, after which the infusion was examined by dissolved isinglass, and yielded a considerable precipitate.

2. 200 grains of the same sort of bark were slightly roasted, and afterwards digested in water; a much darker-coloured liquor was obtained than in the former case; but, although it afforded precipitates by the addition of muriate of tin, acetite of lead, and sulphate of iron, yet not the smallest effect was produced by solution of isinglass.

3. The residuum, with the remaining part of the above-mentioned liquor, was then digested with a small portion

of

nitric acid; this was completely evaporated, and a brown solution was formed by water, which abundantly precipitated gelatine.

4. One ounce of oak bark, reduced into very small fragments, was repeatedly digested in different portions of water until the whole of its tannin was extracted. The residuum or exhausted bark (as it is called by the tanners) was dried, and was afterwards moderately roasted. It was then moistened with diluted nitric acid, which was evaporated in a heat not much exceeding 300° until the bark was become perfectly dry. This was digested in water, and speedily formed a yellowish-brown liquor, which abundantly precipitated gelatine.

5. The bark, which, after being exhausted of its natural tannin, had thus afforded the artificial tanning substance, was repeatedly treated with water until the whole of this last was extracted. The bark was then again slightly roasted, was again moistened with nitric acid, and was gently heated and dried as before. Water being poured on it and digested, formed a brown solution, which copiously precipitated gelatine.

6. The whole of the artificial tanning substance was extracted by different portions of water, and the remainder of the bark, thus exhausted, was again treated in the manner above described, and again afforded a considerable quantity of the tanning substance; so that these processes evidently might have been continued until the whole of the bark had been converted into it.

This might also have been accomplished, if in the first instance, the exhausted bark had been converted into charcoal, and digested in nitric acid, as described in my first Paper; but then, the effects would have been more slowly produced, and much more nitric acid would have been consumed. I am therefore fully convinced, not

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only by the results of the experiments related in this Paper, but also by many others which it would have been superfluous to have stated, that the most speedy and most economical of all the processes which I have described, is that of treating roasted vegetable substances in the way which has been mentioned; and considering that all refuse vegetable matter may be thus converted into a tanning substance by means the most simple, and without any expensive apparatus, I cannot help entertaining much hope, that eventually this discovery will be productive of some real public advantage.

TO BE CONCLUDED IN OUR NEXT.

A Plan for improving the Growth of Tares.

By Mr. THOMAS HEROD, *of North Creak, Norfolk.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

TO be sown broad-cast in October, from ten to twelve pecks *per* acre, with one peck of *wheat*, then ploughed into four-furrow ridges. In the months of April and May, a one-horse-plough (double breast) is to be run through the furrows; this will keep them clean, and admit the air to the roots of the tares, and will keep them clean and growing till Midsummer.

Observations.

Tares being found very useful for the soiling of cattle, and the best plan of growing them being required by the Board, I submit one for their consideration which I have practised seven years with success. They are a plant that contain a great deal of moisture, particularly when young,

young, therefore it is not proper to soil cattle with them in that state without food; those persons who are destitute of that must give them very *sparingly*, or they injure their stock more than they are aware of. On the general plan of sowing, soon after they are at an age proper for the stock, they begin to rot at the bottom; to obviate which, some people sow rye, some oats, and some barley, the stems of the latter being weak, of course they can have no effect: the former soon get hard, and the cattle refuse to eat them; and by endeavouring to avoid them destroy many of the tares, treading them under foot: therefore, on that plan they cannot be grown to so great advantage as might be hoped for. If it had been considered that *air* is the most essential means of the life both of the animal and vegetable creation, a different plan would have been resorted to. It is well known, that tares grow so close together at the tops as to exclude all the external air from the bottoms; and although they keep green at the tops where they receive the air, they continue rotting at the bottoms for want of it. When they are cut for soiling, the stock refusing to eat the decayed part, destroy a great deal of the sound food: the loss to the growers of this plant therefore is not to be calculated! My first attempt of improvement was on two roods of ground for the soiling of two horses, sown as first stated, and ploughed into four-furrow ridges; they continued growing with rapidity to the height of near five feet *clinging to the wheat*. A high wind took them about Midsummer, and bent them all down, but not close to the ground; some yards might be seen up the furrows, which appeared like an arch. These furrows admitted the *light* as well as the *air*, which is also a means of preserving the plants green, for if *air* is admitted and *light* taken away, they may continue growing,

but they will lose their colour. These two roods produced more than my two horses could eat; after Midsummer the remainder were cut, and produced half a load of excellent hay. This land is a sandy soil upon a gravel; six loads of farm-yard dung were ploughed in with the tares. Last year and the preceding year, I had two roods on a black gravel, sown on this plan, had no other manure than a thin covering of mould from an old bank in the same piece; the first crop was but middling; I gave it another thin covering of mould from the headland of the same piece last year, as the ground was weak. I sowed six pecks of tares, and three-quarters of a peck of *wheat;* this proved a *good* crop, and, after soiling two horses with them from the end of May till the middle of August, half a load were cut for seed: I have always found that two roods of tares sown on this plan were *more than two horses could eat.* I am well convinced from my own practice, that tares sown on poor land will improve it, if repeated a few crops; they may also be grown to great advantage, if sown on this plan, as the food will not only be sound and sweet, but also much greater in quantity. It has been supposed that they would be inconvenient to cut on the ridges; but, I believe, they may be cut better than when they are fallen close to the ground and rotten. The reasons for my sowing *wheat* among the tares are, the stems of the wheat are not only strong, and hold the tares up, but they are also so sweet that the stock will eat them with as much avidity as they do the tares, and to as late a time as the tares are proper to be cut for soiling.

An

An Account of the Produce of Milk and Butter from a Cow, the Property of WILLIAM CRAMP, *of Lewes, in the County of Sussex, for one Season, commencing the* 1st *Day of May* 1805, *(that being the Day she calved,) up to the* 2d *Day of April* 1806, *a Space of Forty-eight Weeks and one Day.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

BUTTER.	Number of Weeks.	Pounds *per* Week.	Quantity of Butter.	Sold at *per* lb. *s.*	*d.*	Total value. £.	*s.*	*d.*
From the 1st May to the 7th May, kept no account; sold the calf - - -	1	—	—	1	6	1	7	0
From the 8th May to the 25th June -	7	15	105	1	6	7	17	6
From the 26th June to the 10th Sept. -	11	14	154	1	6	11	8	0
From the 11th Sept. to the 29th Oct.	7	12	84	1	6	6	6	0
From the 30th Oct. to the 3d Feb. 1806	14	10	140	1	6	10	10	0
From the 4th Feb. to the 10th March	5	8	40	1	6	3	0	0
From the 11th March to the 24th March	2	7	14	1	6	1	1	0
From the 25th March to the 2d April, left off milking - - - - - - -	1	3	3	1	6	0	4	6
	48	—	540	—		41	14	0
Deduct for butter sold in the month of August 1*s.* 4*d.* *per* lb. only for three weeks - - - - - - - - - - -	- -	- -	- -	-	-	0	7	0
						41	7	0

MILK.

	Quarts *per* Day.	Quarts.
From the 8th May to the 25th June - -	20 - -	980
From the 26th June to the 10th Sept. -	18½ - -	1424
From the 11th Sept. to the 29th Oct. -	16 - -	785
From the 30th Oct. to the 3d Feb. 1806	12 - -	1176
From the 4th Feb. to the 10th March -	11 - -	385
From the 11th March to the 24th March	9 - -	126
From the 25th March to the 2d April -	5 - -	45
		4921
The milk being measured when milked from the cow, there must be deducted for cream - - - -		540
		4381

	£.	s.	d.
4381 quarts of skim milk, at one penny *per* quart - - - - - - - - - - - - - -	18	5	1
Made in the course of the season, four large waggon load of dung, worth 15*s.* *per* load thoroughly rotten - - - - - - - - - -	3	0	0
	62	12	1
Total expense - - - - - - - -	21	6	2
Profit - - - - - - - - - - £.	41	5	11

EXPENSE.

	£.	s.	d.
Grains consumed the summer 26 weeks, 3½ bushels *per* week, at 4*d.* *per* bushel - - -	1	10	4
Bran, 1½ bushel *per* week, at 8*d.* *per* bushel -	1	6	0
Winter 26 weeks, grains consumed, 8 bushels *per* week, at 6*d.* *per* bushel - - - - - -	5	4	0
£.	8	0	4

Bran,

	£.	s.	d.
Brought forward - - - - - - - -	8	0	4
Bran, 4 bushels *per* week, at 8*d.* *per* bushel -	3	9	4
Half a hundred weight of hay *per* week, at 5*s.* 6*d.* *per* cwt. - - - - - - - - - - - -	3	11	6
Rent of the land whereon were raised the lucern, clover, carrots, &c. - - - - - - - -	0	15	0
To the wages of a man at the rate of 52*l.* *per annum*, supposing him to attend ten cows, the tenth part of which is - - - - - - -	5	4	0
To the farrier for three drinks at the time of calving - - - - - - - - - - - - - -	0	6	0
	£. 21	6	2

The cow was fed with artificial grasses, sown on the following plats of ground within the walls of the prison, containing by measurement as follows:

		Rood.	Perch.
No. 1.	A plat sown with red clover and rye-grass, containing - - - - - - -	0	19
No. 2.	Ditto, sown with lucern - - - - -	0	2
No. 3.	Ditto, sown with cow-grass and white clover - - - - - - - - - - - -	0	17
No. 4.	Ditto, sown with red and white clover	0	18
No. 5.	Ditto, sown with lucern - - - -	0	10½
No. 6.	Ditto, sown with carrots - - -	0	2½
		1	29

The above crops of lucern were cut four times, and the clover three times, during the season, producing (each time) good crops. The cow not allowed to feed on the grass ground, but cut, and given her in a rack in her

her hovel, where she has a plat of about eighteen square perches to range in. I keep but this cow, nor have I had any other since I had her. She is seven years old, and has had five calves; has been in my possession for two years.

Consumed much less food this year than the year before.

Food and Treatment.

Summer season fed on clover, rye-grass, lucern, and carrots, three or four times a day, and at noon-time about four gallons of grains and two of bran mixed together; always observing to give her no more food than she eats up clean. Winter season fed with hay, bran, and grains, mixed as before stated, feeding her often, *viz.* five or six times a day, as I see proper, giving her food when milking; keeping the manger clean where she is fed with grains; not to let it get sour; wash her udder at milking three times with cold water, winter and summer. Never tie her up; lays in or out as she likes; particularly careful to milk her regularly and clean. Milch cows are often spoiled for want of patience at the latter end of milking them.

One man would attend ten cows through the year (with the exception of an assistant at milking times). Feeding milch cows as above stated, they will at all times be in good condition fit for the butcher, if an accident should happen. There will be no ground trampled and food spoiled by cattle running over a vast track of land. I think cattle may be fattened by the same mode of feeding with much advantage; one-fourth part of the land would feed them, a great quantity of manure made, and the beast fatten much sooner. Cattle so fed, have nothing to do but fill themselves and lie down to rest. *No labouring for their food.* I fattened the two

cows

cows I had before this, and made them very good meat in about seven weeks (I found it to answer, although I bought the food at a dear rate,) giving them a little ground barley or oats mixed with the grains and bran. I think cows would nearly double (in the course of the season) their quantity of milk and butter by following the above plan. It is unnecessary for a cow to go dry long before she calves. The thing will tell for itself. When her milk changes brackish she should then be dried off; that may be in three, four, or five weeks, before she calves. Milch cows seldom go dry before, unless it is from neglect, poverty, sickness, or bad milking. Let the milk stand two days in summer and three days in winter before it is skimmed. I have stated no more than one penny *per* quart for skim milk; but I am informed it sells in the town of Lewes for three halfpence, it being worth one penny to put in the hog tub. I fattened two hogs in the summer with no other food than skim milk and grains, making them very good meat, weighing sixteen or eighteen stone each, at 8 lb. *per* stone. Where cows are kept in this way hogs should be kept, as the milk will be (in the summer time) thick and sour, and fit for nothing else but hogs. The people of this country making no use of it as food.

The following is the Pedigree of the Cow in question, which I received from Mr. Holman, a respectable Farmer at Bentley, in the County of Sussex.

The cow belonging to Mr. Cramp was bred by John Holman (my father), at Bentley in Framfield, in the county of Sussex, from a Sussex-bred cow, also bred by John Holman, on the same farm. She was got by a bull bred by Mr. Colgate, at Hampstead-farm in Framfield aforesaid; the father of which bull was also bred by Mr.

 Colgate,

Colgate, for which he obtained a prize-cup at Petworth, on the 20th day of November 1726. She was calved in March 1799.

N. B. Mr. Cramp's cow calved on the 19th day of April, the calf in very fair condition; the cow having been dry for seventeen days *only*, was taken bad with the yellows at the very time of calving, but is now recovered, and going on very well. The calf sold at twelve days old for 1*l.* 10*s.*

On the Culture of Spring Wheat.

By Sir JOSEPH BANKS, *Bart.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

REAL spring wheat, the *Triticum Œstivum*, or summer wheat of the botanists, is a grain too tender to bear the frosts of the winter, but as quick in progress from its first shoot to ripeness as barley, oats, or any other spring corn.

It is well known on all parts of the Continent, and much used in France, where it is called *Blé de Mars*, from the season in which it is usually sown; and in some provinces *Bleds Tremois*, from the time it takes between seed-time and harvest; in Spanish it is called *Trigo de Marzo;* in Portuguese, *Trigo Tremes;* and in German, *Sommer Waitzen;* all which names mark distinctly the difference between this and winter corn.

It does not appear from the older books on husbandry, that it was at any former period much cultivated in England; the more modern ones are in general silent on the subject of it; they mention, indeed, under the name of

of spring wheat, every kind of winter wheat which will ripen when sown after turnips in February. This is probably the reason why the real spring wheat has been so little known; agriculturists in general, conceiving themselves to be actually in the habit of sowing spring wheat, when in reality they were substituting winter wheat in its place, have been little inclined to enquire into the properties of the real spring wheat when they had an opportunity of so doing.

In the lower parts of Lincolnshire, where the land is the most valuable, and consequently the most subject to mildew, spring wheat has been long known, and it is now cultivated to a great extent. Mr. Sers, of Gedney, near Spalding, has this year claimed a premium of the Board for the largest quantity of land sown with spring wheat in 1805; his quantity is 241 acres, and there is no reason to suppose that he added a single acre to his crop on account of the Board's offer. He is a man who, by his skill and talents in agriculture alone, has raised himself to opulence, and possesses a considerable landed estate, for which he is certainly in part indebted to the free culture of spring wheat during the last thirty years.

Mr. Sers sows spring wheat from the 25th of March till the first week in May; for a full crop he sows fourteen pecks on an acre, and expects to reap four quarters; if he sows seeds under it, which is very generally practised, he sows nine pecks, and expects three quarters in return; he finds it thrive nearly equally well on his stiff and his light land; and has found it, by experience, to be exempt from the mildew or blight, and free from all damage of the grub or wire-worm.

The farmers in South Holland, where Mr. Sers resides, uniformly declare that they have been many years ago

 compelled,

compelled, by frequent attacks of the mildew or blight, to abandon almost entirely the sowing of winter wheat, and that they then substituted spring wheat in its place, and have used it ever since: they believe it to be wholly exempt from the mildew or blight. In the neighbourhood of Horncastle, where I live, the land is either light or sandy, or composed chiefly of Norfolk marle, called in that neighbourhood white clay. Such land, though tolerably productive in barley and seeds, is not to be compared with the rich and fertile tracts of South Holland; and yet the culture of spring wheats has of late years increased, and is now increasing fast, because the millers begin to understand its nature, and cease to undervalue it as they did at first.

The grain of spring wheat is considerably smaller than that of winter wheat; in colour it resembles red lammas so much, that it may be mixed with that grain, and this mixture will do no injury to the seller, as spring wheat weighs heavy; nor to the buyer, as it yields better at the mill than from its appearance might be expected; 60 lb. a bushel is about its usual weight. Mr. Sers's, of this year, weighed 61 lbs. and he has sold some mixed with less than half of red lammas, at the usual market-price of the winter wheat of the last harvest, though the winter wheat is better in quality this year, and the spring worse than usual.

In the countries best acquainted with its culture, spring wheat is preferred to all other corn for raising a crop of seeds. This is owing to the small quantity of leaf it bears, less perhaps than any other corn, and to the short duration of the leaf, which fades and falls down almost as soon as it has attained its full size.

In cases where red wheat has been damaged by the wire-worm, a mischief which seems of late years to have increased

increased in this island, spring wheat appears to hold out an easy and a simple remedy. In the first week of May the ravages of the worm have abated somewhat; if then the seed of spring wheat is at that time dibbled, or only raked with a garden-rake into the naked spots left by the worm, though it will not attain the growth at which the worm begins to prey upon it till he has changed his state for that of a winged beetle, will certainly be ripe as soon as the winter wheat, and may be thrashed out and sold with it; or if it is preferred, may be reaped separately, as the appearance of the ears, which in the Lincolnshire sort have longer beards or awms than the rivett or cone wheat, will point it out to the reapers in such a manner that no great error can happen in separating it from the lammas.

In years of scarcity, this wheat offers a resource which may occasionally be of the utmost importance to the community; of this the Board were very sensible last spring, when they offered premiums for the increase of its culture, which have had the effect of rendering it much more generally known than otherwise would have been the case. The price of wheat seldom advances much, even in very scarce years, till a considerable portion of the crop has been thrashed out, and the yield of it by this means actually ascertained; but this does not take place till the seed-time of winter wheat is wholly over; no speculation, therefore, of sowing an increased quantity of that grain can be entered into during the first year of a scarcity; but before the end of April the question of the average-yield of the preceding crop will be generally known, and when it is much below the usual proportion, there can be no doubt that a large quantity of spring wheat will be sown, if the seed can be easily procured.

It

It is rather melancholy to reflect, that the progress of agricultural improvements has in some instances advanced in the inverse ratio of the utility of the novelty recommended to the public. Tobacco and potatoes reached Europe at much the same period, the time when Virginia was settled by Sir Walter Raleigh; but an ineffectual firmaum was issued by the Great Mogul against the use of tobacco, long before potatoes were commonly cultivated in the gardens of England, and that nauseous weed reached the farthest extremities of the Chinese empire, in spite of the obstacles placed by the government of that country, against the introduction of novelties of any kind, long before potatoes had occupied any extensive portion in the field-cultivation of this island.

Lest the revival of the culture of spring wheat, even under the liberal protection it has received from the Board, may be retarded by this principle, which seems to be inherent in the nature of mankind, it may be advisable to state here, that in the neighbourhood of Boston and Spalding, in Lincolnshire, the cultivation of it is now fully established, and likely to continue; from either of these places, therefore, the seed may at any future time, as well as at present, be obtained without difficulty; and as there is a water communication between these towns, and as Boston is a sea-port, it may always be brought to London, or any other maritime part of England, at a small charge.

In times when dearth recurs, which will occasionally happen as long as the manufacturing interest insist on keeping the price of corn, in a plentiful harvest, below the actual cost of growing it, speculations on the sowing of spring wheat may be carried so far as to raise the price

price of seed, till a saving in it becomes a matter of political as well as of economical importance; an experiment is therefore added, to shew that spring wheat will succeed as well by dibbling as by broadcast, made in the spring 1804.

Mr. William Showler, an intelligent farmer at Revesby, in Lincolnshire, dibbled four pecks and a half of spring wheat on one acre and two roods of middling land, which had borne turnips the winter before, and had no extraordinary preparation for this crop; the rows were eight inches asunder; the holes four inches asunder and two inches deep: two grains were put into each hole.

The produce from the quantity of 4½ pecks of seed was 7 quarters, or 4 quarters, 1 bushel, and 1 peck an acre; a fair crop, and as much at least as could have been expected from 18 or 21 bushels sown broadcast on the same land.

By a careful analysis in the wet way, conducted by Professor Davy, of the Royal Institution, the following results have been obtained from different kinds of wheat:

	Gluten.	Starch.	Insoluble Parts.
From 100 parts of best Sicilian wheat	21	75	5
Ditto of spring wheat of 1804 - -	24	70	6
Ditto good English wheat of 1803 -	19	77	4
Ditto blighted wheat of 1804 - -	13	52	44

From this ingenious analysis we may fairly deduce, that bread made of the flour of spring wheat is more nutritious than that made of winter wheat, because spring wheat contains a larger proportion of the gluten or half-animalised matter; and also that a miller ought not to deduct from the price of spring wheat more than 2 *per cent.* on the money price of winter wheat of the same weight,

weight, as the excess of the weight of insoluble matter, or bran, is no more than 2 *per cent.* when compared with good English winter wheat.

Bread made of spring wheat is rather less white than that made of the better sorts of winter wheat; but it is allowed to be more palatable in Lincolnshire, where it is best known. Both these qualities are probably owing to the excess of gluten contained in it.

Memoir on Coffee. *By* C. L. CADET.

From the ANNALES DE CHIMIE.

CHEMISTRY has acquired such an elevated rank, and has been employed on objects of such high consideration, that it seems degraded when applied to the examination of substances that are common and in daily use. A chemist who decomposes a rare, foreign, and often useless production is eminently distinguished, while he who descends to analyse what forms a part of our food, or any of the necessaries of life, is hardly noticed; and it is undoubtedly owing to this prejudice that the analysis of coffee has been neglected, since the happy revolution in chemistry.

However, when it is considered that this single colonial production, renders France tributary of more than 30 millions of livres *per annum*, that this expense brings with it an enormous consumption of sugar, always to the profit of foreigners, coffee appears of sufficient importance for chemists to search into its nature and properties.

Bourdelin, Geoffroy, Ribiner, and some others, have already published analyses of coffee, but their labours have not elucidated the subject; for the science, when they wrote, was not sufficiently advanced, and the most useful

ful reactives were unknown to them. Without deeming myself more able than these gentlemen, I shall perhaps succeed better, and I hope at a future time to be able to pursue the subject.

EXAMINATION OF UNROASTED COFFEE.

Coffee treated with boiling Water.

When boiling water is poured upon coffee, in the state in which it is brought from the colonies, the water becomes of a yellowish-green *. If the action of the heat is continued, the decoction becomes brown, and a thin scum is formed which remains insoluble; when filtered it passes very clear, and becomes turbid as it cools.

A little caustic potash, poured into this decoction, makes it browner. Ammonia produces the same effect. Lime water produces an abundant flaky precipitate; sulphate of iron converts it into black ink. The solution of gelatine does not become turbid by its mixture with the decoction. Oxygenated muriatic acid only partly discolours it: and if an alkali be poured upon this mixture, the liquor becomes red.

Distillation.

Eight pounds of water poured upon one of unroasted coffee were submitted to distillation. I obtained a water very aromatic, with some drops of concrete oil floating on it, and which were something like that of *galé* or *myrica cerifera.*

The decoction that remained in the still was viscid. I diluted it with a little water, poured some alcohol upon

* When the coffee is fresh gathered, its decoction is of a beautiful emerald green. It may be made into a lac. M. Dupont de Numours has informed me, that in the colonies they use it to wash and colour plans.

 it,

it, and it precipitated abundantly a matter, which, when collected on the filter, was soluble in water, and had all the characters of a mucilage. The coffee on which water had been distilled, when dried in a stove, and digested in alcohol, furnishes a tincture, which water precipitates.

The aqueous decoction of unroasted coffee does not give a red colour to the vegetable blue colours: it even gives a green colour to turnsole. All the chemists who have analysed coffee before me have said, that the decoction held in suspension a free acid, which reddens the vegetable blue colours. Geoffroy has even asserted that water distilled from a water-bath upon coffee became very acid. I have tried five different kinds of coffee, I have repeated the experiments more than twenty times, but the decoction has never appeared to me to be acid.

It decomposes sulphate of alumine, and precipitates the earth, which it slightly colours.

Unroasted Coffee treated with Alcohol.

Alcohol when infused, even cold, upon unroasted coffee, colours it slightly, and holds in solution a resinous extractive principle very abundantly. If water be poured into it, the tincture becomes milky, and the resin is precipitated of a dirty white. With a solution of sulphate of iron, the precipitate is green: with muriatic acid, it is a fawn colour. The coffee, after draining the alcohol from it, by treating afterwards with water, furnished still some extractive matter and mucilage.

It may be concluded, from these first experiments, that unroasted coffee contains, 1. an aromatic principle soluble in water; 2. a very small quantity of essential oil; 3. a considerable portion of resin; 4. a gum in still greater quantity; 5. some gallic acid, but no tannin; 6. extractive matter; 7. a little alumine.

Observations,

Observations.

If the decoction when filtered warm, becomes turbid as it cools, it is because it holds in solution, with the aid of heat, a little resin. Alkalies make it brown, the usual effect of these reactives on vegetable decoctions. Lime-water precipitates it; because one part of it forms gallate of lime, and the other unites with the gummy extractive matter, and falls to the bottom. It is the same with sulphate of alumine. Spirit of wine separates the mucilage, because gums are not soluble in alcohol; and water precipitates the alcoholic tincture, because water will not dissolve resins. This precipitate is white when formed by water, on account of its extreme division; green by sulphate of iron, because it is mixed with gallate of iron; fawn-coloured when made with oxygenated muriatic acid, because the oxygene in adhering to the resin sets a little carbon free. The insoluble scum which is formed upon the decoction is a little vegetable albumen, coagulated by the boiling water. To obtain it, the water must have remained for some time cold upon the coffee before heating it.

Approximative Proportions.

Though it may be of little use to seek for the proportions of the immediate principles of coffee, since these proportions will certainly vary according to the ripeness of the berry and the place from which it comes, I have notwithstanding thought it necessary to ascertain them as nearly as possible. From several comparative experiments, I have found that eight ounces of coffee give about one ounce of mucilage, one dram of resin, one of extractive colouring matter, 3½ of gallic acid, 5 ounces 3 drams and a half of *parenchyme*, and 10 grains of vegetable albumen.

It has been long known that coffee germinates in boiling water (See Dictionnaire de Bomare, article Café,) and I have ascertained the fact; but it does not germinate in boiling alcohol, either because its temperature is not sufficiently elevated, or that water is necessary to its germination; or else that alcohol destroys the vegetative action.

I have compared the decoctions and tinctures of three kinds of unroasted coffee, namely *Moka*, *Martinique* and *Bourbon*. The principles of the two last have appeared to me to be of the same proportions. Moka differs essentially from the others. Its decoction was much less charged, its alcoholic tincture was of a higher colour than that of the Bourbon and the Martinique; it contains less gum, less gallic acid, more resin, and was more aromatic than the others.

Roasted.

To become acquainted with the changes that roasting occasions in coffee, I examined the phenomena that took place, whilst this berry was burning in the open air.

At first the coffee increased in bulk while imbibing the heat, it crackled and became of a fawn colour; the pellicle that envelopes the berry (and which is called *arille*) was detached, and as it is very thin and light it flies off with the slightest agitation. The coffee then had a very pleasant aromatic smell, which increased, and the berry smoaked and became browner; the smell then changed, and appeared to be slightly empyreumatic. The coffee exuded, and became oily on the surface *, it ceased to smoke,

* M. Parmentier wrapped some roasted coffee in a state of exudation in some filtering paper; this paper imbibed the oil and remained greasy and transparent for more than a year, from which we may infer that a fat oil exists in the grain. I could not however obtain it isolated, either by pressure, by ebullition, or by caustic alkalies.

smoke, and if the action of the heat was continued it became carbonized.

The interval that separates the instant when the coffee becomes coloured from that in which it becomes carbonized is so short, that it is difficult to determine the point of time at which the operation should be terminated, in order to preserve to the berry its most agreeable properties; but, to come as near as possible to this point, so important to be known, I have noticed in roasting it three distinct periods; first, when the berry loses its natural colour, and takes that of dried almonds or bread raspings; secondly, when it assumes the reddish brown colour of the Indian chesnut; and thirdly, when it becomes almost black, but is not quite carbonized.

I took six ounces of Martinique coffee, and divided it into three parts, which I roasted separately; and each part took one of the three preceding appearances.

The two ounces that were slightly roasted, and which were the colour of dried almonds, lost two drams on the fire. I marked this proof No 1.

The two ounces roasted till they took a chesnut colour lost three drams during the operation. I marked this portion No 2.

The two ounces roasted till they were black lost three drams 48 grains. I marked this No 3.

No 1 passed with difficulty through the mill * when infused cold; the infusion contained tannin, and precipitated the solution of gelatine. Its taste was very aromatic †, its

* M. Cadet de Vaux, my uncle, has observed that to grind coffee is not the best method of preparing it; and that the grain when pounded in a mortar preserves more of the aroma than that which has been passed through a mill.

† The desire to retain the aromatic flavour which a strong heat dissipates, has given rise to two processes, which are not without effect. The

its flavour like almonds; it was not at all bitter, and the raw smell was very decided. When infused warm, its aromatic taste was the same; its flavour reminded me of almond cake; it had no bitterness, and the rawness was less sensible.

No. 2 was more easy to grind; when infused cold it furnished less tannin, its aromasic taste was weaker, sugary; it had no bitterness nor rawness. The warm infusion presented neither more flavour nor more aroma.

No 3 was very easily ground. Infused cold, it had very little aroma, its flavour was empyreumatic and rather bitter; it formed a precipitate scarcely sensible with the solution of gelatine. The warm infusion was more bitter, more empyreumatic, and the aroma was more distinct.

All these infusions contained a portion of mucilage and gallic acid, but tannin in an inverse progression; for the proportions of gum and acid augmented as long as the action of the heat was continued, while that of the tannin diminished.

M. Bouillon Lagrange, in an excellent memoir on gall nuts, has already considered the gallic acid as a modification of tannin, and his experiments serve to confirm his opinion.

The first, which is used in India, and among some of the French, consists in putting a little fresh butter into the roasting cylinder upon the coffee when it begins to change its colour; it must not be more than just enough to make the surface of the grain shine a little. The butter retains a part of the essential oil that would otherwise evaporate. This method is not a bad one; but it sometimes gives a particular flavour to the coffee, which is not to every one's taste. The second process consists in spreading the roasted coffee while yet warm and moist upon a white paper, and sprinkling a little sugar over it; the sugar absorbs the oil of the coffee, and retains its aroma. This method does not appear to me to make the coffee pleasanter, and it renders uncertain what quantity of sugar should be put into a cup of coffee.

Coffee roasted.

As the immediate principles of coffee are not equally soluble or volatile, it was necessary to examine comparatively both the cold and warm infusions of the three sorts of coffee, and their decoctions likewise.

Infused with cold Water.

I poured eight ounces of distilled water upon one ounce of coffee roasted and ground. I left it to infuse for two hours, and then filtered it. The infusion was of a fine brown, very clear, it did not redden paper, became black by sulphate of iron, and precipitated slightly a solution of gelatine. Alcohol separated a little mucilage from it, and gave to the infusion the smell of Geneva. Moka, Bourbon, and Martinique coffee presented the same characters.

Warm Infusion.

I infused, for a quarter of an hour, an ounce of coffee roasted and ground in eight ounces of water at 70 degrees of heat; this infusion did not redden turnsol, it did not precipitate the solution of gelatine, and with sulphate of iron it formed ink. Alcohol separated more gum than from the cold infusion. The three kinds of coffee exhibited the same appearances in these experiments.

Decoction.

I boiled two ounces of ground coffee in a pound of water; and kept it boiling for two hours. The decoction had a smell infinitely less pleasant and less aromatic than the infusion. It did not change the colour of blue paper, neither did it precipitate the solution of gelatine, and sulphate of iron blackened it. Alcohol separated much more mucilage than was found in the infusions, observing the same proportion. The three kinds of coffee gave the same results.

If a decoction of filtered and limpid coffee be boiled for a long time in contact with the air, it becomes turbid and deposits a black powder, which has been sometimes taken for resin, but it is only extractive matter very much oxygenized.

If medical men were to examine more particularly the effects of the atmospheric air on vegetable decoctions, they might throw some light on the properties, more or less powerful, of certain medicaments.

Extract of Coffee.

The decoction of coffee filtered and evaporated to the consistence of extract, has not the aromatic smell of the infusion; its flavour is bitter. Heated with alcohol, this extract colours the liquor by its extractive matter, but this tincture is not precipitated by water.

Hence we must conclude that the decoction of coffee, which has been filtered or suffered to rest till it becomes clear, contains no resin.

Alcoholic Tincture of roasted Coffee.

Roasted coffee digested in Alcohol, gives a deeply-coloured tincture, from which water precipitates a greater quantity of resin than dry or raw coffee. In the latter the resinous matter is white; in the tincture of burnt coffee it is fawn colour.

Observations.

The result of these experiments is, that roasting coffee developes its oderiferous and resinous principles, and forms tannin which is only soluble in cold water; a very singular phenomenon. Gallic acid is manifested in coffee at every degree of temperature of the water that is used as a dissolvent. The gum and the colouring extractive matter are more plentiful in the decoctions than in the infusions

fusions; but the aromatic principle is more sensible and pleasant in the latter.

Roasted Coffee, distilled.

I distilled several litres of water upon some roasted coffee; this water became charged with the aroma of coffee, and carried with it a few drops of concrete essential oil, like that obtained by the distillation of dry coffee. The re-actives have not demonstrated, in this water, the presence of any substance in solution.

Infusions and Decoctions compared.

To know the different degrees of solubility of the principles of coffee, it remained to submit the same roasted powder to the successive action of infusion and decoction. For this purpose I placed two ounces of coffee in a filter; I passed cold water through it, till the re-actives ceased to indicate the presence of any matter in solution. It requires sixty-eight ounces of cold water to deprive this coffee of all its soluble matter. I divided this water into seventeen portions, of 4 ounces each, as soon as it had passed through the filter. These seventeen portions all of them contained gallic acid, in proportion to their order; the four first contained gum, and the first only precipitated a solution of glue, which announced the presence of tannin.

The coffee on the filter was dried in a stove; I afterwards poured upon it eight ounces of water at 75 degrees of heat; the odour of this second infusion was agreeable, but weaker than that of coffee prepared for the table; when examined by re-actives, it furnishes a little mucilage and much gallic acid. I found neither tannin nor resin in it.

I took

I took the same powder of coffee already washed in cold, and infused in warm water, and boiled it in six ounces of water till reduced to four. This decoction contained much gum and gallic acid, a little aroma, and exhibited no signs of tannin or resin by the re-actives.

Observations.

These experiments prove that cold water deprives roasted coffee of a little of the tannin that it contains, of a part of its extractive matter, of a great deal of its aroma; but that it takes up but a small portion of its gum and of its gallic acid. We see that the warm infusion is already more charged with these two last principles, but that its aroma is weaker. In short, we may perceive that continued decoction dissipates a great portion of the aromatic odour, and the water becomes highly charged with gum and gallic acid. If resin be found in it, it is only in a state of suspension. It disturbs the transparency of the liquor, and precipitates when left to rest.

Ashes of Coffee.

Though it be of little consequence to know what coffee contains when reduced to ashes, I nevertheless incinerated about half a pound; the ashes were tolerably light washed; in distilled water, they shewed by analysis but a little lime and a very little potash. I sharpened the washings with a little nitric acid, and the filtered solution precipitated prussiate of potash in a fine blue, and was abundantly precipitated by oxalic acid. Barytes made no alteration in it, and nitrate of silver turned it white; the ashes of coffee, therefore, are composed of charcoal, fire, lime and muriate of potash. I thought it unnecessary to estimate their proportions.

I expected to have terminated this analysis here, when M. Parmentier read to the Societé de Pharmacie a very

minute

minute memoir on coffee by M. Payssé, who has already published several interesting works. It is said in this memoir first that the precipitate, formed by mixing a decoction of coffee with sulphate of iron, is only soluble in nitric, sulphuric, phosphoric and oxalic acids; secondly, that coffee contains no gallic acid; thirdly, that it contains a particular acid *sui generis*, which the author calls *acid of coffee*, and which he obtained by following the process of M. Chenevix, which consists in making a decoction of unroasted coffee, filtering it, precipitating it by muriate of tin, and decomposing the precipitate by sulphuretted hydrogene gas *.

The authority of M. Chevenix, and the usual accuracy of M. Payssé's operations, induced me to make several experiments, to be assured of the new facts which they announce.

I boiled for two hours two ounces of Bourbon coffee in half a pound of water; this decoction presented such phenomena as I had already observed; it took a tint of yellowish green, which became more lively by the separation of a little albumen; and oxygenated extractive matter was precipitated. I mixed a part of this decoction with a solution of sulphate of iron, and obtained a precipitate of a very deep blue, bordering upon black; I redissolved this precipitate in oxygenated muriatic acid, both strong and weak in acetic acid, in tartarous acid, in nitric acid and even in benzoic acid. The muriatic acid gave a yellow tint to the liquor, which returned to its

* Memoire de M. Chevenix (Journal de Bruselles, No. 7; Germinal an 10, et Vendémaire an 11: page 63 *et suiv.*—Annales de Chimie, par Van-Mons, Fructidor an 10, No 129, page 326). M. Chenevix does not say that the substance which he obtained by the above process is an acid, but that it is a new product, the nature of which he has not determined.

transparency, depositing a precipitate, tolerably heavy, of oxygenated extractive matter. This deposit, when redissolved by ammonia, gave to the liquor a fine red brown colour.

The immediate precipitate of sulphate of iron, dissolved in acetic acid, had the same characters as the preceding, except the colour, which was a violet blue; it has besides been redissolved by ammonia. The other acids have given nearly the same precipitate as the muriatic acid; their action has generally followed the order of the acids.

I treated in the same manner some precipitate of sulphate of iron, obtained by gallic acid; and the results were exactly like the preceding.

I precipitated, by muriate of tin, what remained of the decoction of coffee. This salt occasioned in the liquor a very plentiful deposit. I washed this precipitate, till the washings presented no signs of acidity; I afterwards put this metallic compound into a tubulated flask, and I poured into it a good deal of distilled water.

I disposed this apparatus, which is Woulf's, so as to make sulphuretted hydrogen gas pass through the precipitate. From the first portions of gas that came over, the mixture acquired a brown colour, which became darker in proportion as the liquor was saturated with sulphuretted hydrogen gas. The precipitate was decomposed, it formed an hydro-sulphuret of tin, and the disengaged acid passed into the liquor. This liquor, filtered, was evaporated by a mild heat till it was reduced to one-eighth. This product, considered by M. Payssé as acid of coffee, appears to me to be nothing more than gallic acid. I not only submitted it to the action of all the reactives, comparatively with the acid drawn from gall-nuts, by the usual method; but, not to leave any doubt, I

treated

treated some gall-nuts by the same process. Muriate of tin in this proportion formed a precipitate more plentiful than in coffee. This precipitate, decomposed, like the preceding, by sulphuretted hydrogen gas, furnished an acid of the same colour, the same flavour, possessing the same properties, and shewing no difference except in the proportions. I think, therefore, that it may be concluded, that no such thing as an acid of coffee exists, but that coffee contains less gallic acid than gall-nuts.

It is possible that this gallic acid offers, in its combinations and its compounds, some slight differences from the acid drawn from the oak gall, but it is nevertheless of the same nature. It is well known that the immediate materials of vegetables, though of the same species, and perfectly analogous, are not strictly identical. Gums and sugars vary in their physical properties; yet the saccharine substance and mucilage are the same thing, chemically considered *.

Proust has proved that the tannin obtained from several vegetables is in some respects different; it is therefore possible that the gallic acid drawn from coffee may not be absolutely the same as that of gall; but it is not a distinct acid.

RECAPITULATION.

From the above analysis it appears to be demonstrated, that the coffee-berries, or the coffee of commerce, contains an abundant quantity of mucilage, much gallic acid, a resin, concrete essential oil, some albumen, and a volatile aromatic principle. To these principles are

* The fecula of potatoes does not resemble that of wheat, which likewise differs from the fecula of sago, arum, mace, &c. Yet all chemists affirm that it is an amylaceous substance, and they find the same characters.

added

added those which are to be found in many vegetables, such as lime, potash, carbon, iron *, &c. Roasting developes the soluble principles; but it should be very moderate, if it be desired to preserve the aroma, and not to decompose the acid, the gum and the resin.

Roasting adds a new principle, which is the tannin (in a very small quantity); the cold infusion is very aromatic, but little charged with mucilage and gallic acid; the warm infusion preserves some aroma, and the dissolved principles are there in such proportions as to flatten the taste; the decoction has little aroma, and is strongly charged with gum and gallic acid; even resin is found in it, in suspension; it is not so pleasant as the infusion.

The coffees of Bourbon and Martinique have no sensible difference; but the Moka, as we have already remarked, is more aromatic, less gummy, and more resinous. It is probable that the resin of coffee, like that of most astringent vegetables, has particular medicinal properties. As it cannot be obtained either by infusion or an aqueous decoction, the habitual use of coffee cannot instruct us as to its action on the animal economy; it remains therefore for medical men to make such experiments on this subject as they may think likely to be useful. If I may be permitted to draw from this analysis a few precepts applicable to the economical use of coffee, I shall say that it is possible to make excellent coffee with

* It is very common for iron to be present in a vegetable, but it is a very remarkable phenomenon when it is present in a vegetable that contains much gallic acid, without this acid being combined with it, and giving a blue or black colour to the vegetable. It has appeared to me worthy of research; and I have made comparative analyses of the ashes of gall nuts, where I have likewise found a tolerable quantity of iron.

all

all the different kinds, provided it be not adulterated. Amateurs require three properties in their coffee; namely, an agreeable aroma, a flavour rather austere, a fine colour, and a certain density which they call *body* *. To possess all these properties, I think it should be prepared in the following manner. First, choose a coffee which when dry has no mouldy or sea taste; second, divide the quantity to be roasted into two equal parts; third, roast the first merely till it takes the colour of dried almonds, and has lost one-eighth of its weight; fourth, roast the second part till it is of a chesnut colour, and has lost one-fifth of its weight; fifth, mix the two parts together, and grind or rather pound them; six, neither burn nor infuse the coffee but on the day in which it is to be drank; seven, pour upon four measures of coffee † four cups of cold water, put this infusion aside to drain; eight, pour upon the same coffee three cups of boiling water, and mix the water which is drained from it with the first, six cups of coffee ought to be obtained from this; nine, heat the coffee hastily just before it is wanted, and do not suffer it to boil; ten, make use of a vessel of porcelain, earthen-ware, or silver, to infuse it in ‡. This process, which is strictly conformable to the theory, I have found from experience to be the most economical.

* Some orientals think so much of this density, that they reduce their coffee to a very fine powder, leave the pulp in their infusion, and take it thick like a clear soup.

† A measure is half an ounce.

‡ The apparatus of Belloy or Henrion, tinmen in the Rue de la Loi, may serve as models for executing them in silver or porcelain.

Memoir

Memoir on Roman Alum, compared with that which is manufactured in France. By Messrs. THENARD *and* ROARD. *Extracted by M.* BOUILLON LAGRANGE.

From the ANNALES DE CHIMIE.

THE art of making alum had its birth in the East, and it remained for a great number of years the exclusive property of a few towns in Syria: transported into Europe in the fifteenth century, it soon found its way into Italy, where that manufactured at Tolfa acquired such a great reputation, from being constantly of the same quality, and for its purity. But this art, still in its infancy, improved but slowly; and it was at least three hundred years after the above-mentioned period (when chemistry was sufficiently advanced to discover the component parts of bodies) before it made any considerable progress; then Margraff, Monnet, Exrleben, and Bergman, occupied themselves with analyses of such alums as were best known. Bergman in particular was so strongly persuaded of the importance of the subject, that in his small tracts he has made it the subject of a very long dissertation, in which he describes with care every thing relating to their history, preparation, analysis, and purification; he particularly insists on the necessity of separating the iron with the greatest care by repeated crystallisations; and he assures us, that by this means, which he caused to be adopted in two manufactories, alum may be made as pure, and even purer than the Roman: nevertheless, the work of this celebrated Philosopher contains some erroneous ideas, which were reserved to modern chemits to rectify.

M. Chaptal, who has enriched our arts with a great number of applications equally new and ingenious, was

the

the first to discover the error into which M. Bergman had fallen in proposing the saturation of acid leys by argil; and the simultaneous discoveries of Messrs. Decroisilles, Chaptal, and Vauquelin, on the action of potash in the formation of alum, and on the divers combinations of sulphuric acid with alumine, soon left us nothing farther to desire on this subject. These discoveries doubtless occasioned the establishment of several manufactories of alum; of which the produce, though very like that of Tolfa, has neither diminished the high estimation it enjoys in all manufactories, nor lowered its price. Such philosophers as were undecided waited with impatience the solution of this important problem, when M. Vauquelin made known the results of his researches, in the analysis of the Roman alum, compared with that of other alums best known. He has proved that the proportions of the principles which composed these alums were strictly the same, excepting the trifling difference of a few atoms of sulphate of ammonia and iron, which are scarcely appreciable in the Roman alum. He terminates this interesting analysis, by saying that if these alums are as different as the dyers pretend they are, we have not the chemical means of discovering their cause; but that to him it seems more than probable that the difference has been exaggerated, and that the manufactured alums free from iron should be as good for every purpose as the Roman: that farthermore, to be assured of it, it was necessary to submit them to comparative experiments in dyeing.

Encouraged by this work, the best informed manufacturers improved the produce of their manufactories still more, and supplied the trade with alums, which only required another name and another appearance to enjoy all the estimation of the Roman alum.

 But

But they abused the advantages obtained by this predilection, and soon intrdouced into the trade considerable quantities of alum from Liege and Javelle, to which they had given all the external appearances of that of Tolfa; and most of the manufacturers and dyers who at first had been deceived by this resemblance, sought with no less eagerness the true Roman alum, for it was much easier to deceive than to convince them.

Such was the state of our knowledge with respect to alums, when the Society of Encouragement, always animated with the desire of giving our manufacturers a superiority over the foreign ones, thought proper to propose a prize for a method of giving to our alums all the properties of the Roman alum. The Society of Encouragement having directed Messrs. Thenard and Roard to compare this alum with that of French manufacture, in order to state the difference of their component parts, or their effects in application; after they had employed themselves in these researches, they thought it proper to submit the results to the Institute, and to lay before it the numerous experiments which they had made for the purpose of resolving this question. They were particularly careful to procure alums of French manufacture in the state in which they were delivered for sale; and likewise, to avoid all errors, they went themselves in search of the quantity for which they had occasion, either in the manufactories or in the dépôts, and they have always taken promiscuously a great variety of crystals from among the quantities that they found there.

It was especially of the highest importance to procure Roman alum unmixed; and for that purpose Messrs. Thenard and Roard applied to M. Schlumberger, their colleague, who is the agent at Paris for the proprietors of Roman alum, and to whom the goods are always consigned.

signed. M. Schlumberger very obligingly endeavoured to satisfy them in their enquiries; he not only caused several barrels to be staved, to enable them to judge of the accidents, the form, and the colour of crystals, but he likewise had a great number opened, from each of which they took as much as they required to complete 30 kilograms. The pre-eminence of the Roman alum, especially of that disseminated in commerce, being a subject of discussion between the chemists and manufacturers, Messrs. Thenard and Roard thought that to terminate it, it was necessary not only to analyse the best-known alums in the great way, compared with the Roman, but that it was particularly necessary to make very numerous and very exact experiments in dying on such woven goods as are most in use, and with such colours as are most known; and they thought that if, after the accumulation of facts, they should find an immediate and necessary relation between the results of the analyses and the experiments of application, between the principles contained in the one and the consequence of the effects obtained by the others, that all the difficulties would be removed, all doubts dispelled, and that the theory, united with the practice, would conduct them to a complete solution of the question.

The French alums which they compared with the Roman were those of Bouvier, Liege, Javelle, and Curaudau.

Before they compared the effects of these different alums in dying, the first care of Messrs. Thenard and Roard was to submit them to all the analytical experiments already made by the before-mentioned chemists: they likewise determined at once the proportions of acid, alumine, potash, and water; and they recognized what Messrs. Bergman, Vauquelin, and Chaptal, had already

 announced,

announced, the dangerous influence of iron. Their experiments in this way compose the first part of their memoir.

FIRST PART OF THE ANALYSIS OF ALUMS.

First Experiment.

To determine the proportions of sulphuric acid, they dissolved in sixteen litres of water 489 grains of the above-mentioned alums, entirely deprived of the powder which covers the surface of some of them *.

Into all the solutions of these alums, when completely clear, they poured muriate of barytes unto a perfect saturation, and even to a slight excess, in order to be certain that all the sulphuric acid was precipitated. Each of these solutions took precisely the same weight of muriate of barytes. The precipitates were washed in 90 litres of water; and when that of the last washing was only slightly troubled by nitrate of silver, as well as the water employed for this purpose, they collected them with the greatest care.

Dried and calcined at a red heat during an hour, the weight of the sulphates of barytes were,

Alum of Rome, No. 1, - - - -	489gr	42
Alum of Bouvier, No. 2, - - -	490	70
Alum of Liege, No. 3, - - -	490	27
Alum of Javelle, No. 4, - - -	490	27
Alum of Curaudau, No. 5, - -	488	23
Mean term - - - - - - - - -	489	63

* The analysis of the rosy powder of the Roman alum yielded a saturated sulphate of alumine and of potash, some silex and oxyd of iron.

Messrs.

Messrs. Thenard and Roard adapted the proportion of 26 to 100 of sulphuric acid in the sulphate of barytes, because that is the mean between the results of the analysis of this sulphate obtained by one of them, and between those found by M. Berthollet, after very careful experiments.

This determination of the proportion of sulphuric acid being the most important experiment, they made it a second time with the same exactness as at first, and they found no difference between the quantities of sulphate of barytes obtained by the two analyses.

Second Experiment.

The equal quantities of sulphate of barytes which Messrs. Thenard and Roard extracted by their preceding operations, leaving them in no doubt as to the proportions of sulphuric acid contained in the alums which they had examined, they thought it unnecessary to operate upon any more than those of Rome, Bouvier, and Liege, in determining the proportions of the other principles. These alums presented at once a manufactured alum and two natural alums, of which one is the most in use, and the other is the most esteemed. 489 grains of each of these three alums, well pulverized, were dissolved in 16 litres of warm water, and decomposed by the same quantities of ammonia, of which they were careful to put a very great excess. The alumine was washed in 60 litres of water, and when that of the last washing precipitated no more muriate of barytes, they then collected them, and dried them in a large silver basin. When calcined and kept at a red heat for an hour, they weighed, No. 1, Rome 60^{gr} 92. No. 2, Bouvier 61^{gr} 82. No. 3, Liege 61^{gr} 02. Therefore Messrs. Thenard and Roard found in these alums exactly the same quantity of alumine; for the

the little difference they observed between these quantities was not equal to a gram, and this difference is always inevitable in such a long series of operations.

The authors of this memoir took so much care to wash the alumine, and not to take off the washings till the deposits were entirely formed and the liquid perfectly clear, that they could have no fear of having indicated results that were too small; and they could not be too large, since dissolved in nitric acid, the liquor did not make the muriate of barytes turbid; they were therefore completely disengaged from the sulphates which might have augmented the weight.

Third Experiment.

The 60 litres produced by washing each of these alumines were evaporated to dryness in a large silver basin; and the products obtained were boiled for several hours with their weight of quick lime.

The residue was treated four times successively with boiling water, to take away entirely all the soluble parts; the different washings were evaporated to dryness, and redissolved at several times in very small quantities of distilled water, in order to separate entirely the last portions of sulphate of lime.

The solutions of each of the sulphates of potash were evaporated for the third time, and at last heated at a red heat in a vessel of platina.

The weight of the sulphates of potash likewise obtained was, No. 1, Rome 77^{gr} 05. No. 2, Bouvier 76^{gr} 80. No. 3, Liege 77^{gr} 33. These sulphates afforded no precipitate by oxalate of ammonia, and became but very slightly turbid by nitrate of silver; they contained a little alkali in excess, but in so small a quantity that a few grains of sulphuric acid were sufficient to saturate it.

Messrs.

Messrs. Thenard and Roard treated these sulphates thus by lime, in preference to calcination; for they were assured that in calcining them, they should only obtain an acid sulphate of potash, a part of which is almost always volatilised.

This analysis of sulphate of potash, repeated several times successively, constantly offered the same results, and demonstrated that 100 parts of this salt is composed of,

Sulphuric acid, 36,40. Potash, 63,60.

Fourth Experiment.

Being desirous of ascertaining whether the alums which they had analysed contained any ammonia, they treated them with caustic potash and lime; and as they obtained nothing by this method, they heated them strongly in a retort with their weight of quick lime in powder; but they could not discover the slightest trace of it. Indeed, say the authors of this memoir, we should have been much more astonished to have found this substance, which we were pretty certain could not be one of the constituent parts of the manufactured alums submitted to our essays. As to the natural alum of Liege and Rome, when they do not add urine for their formation, it necessarily follows that ammonia exists in the ore, and the heat to which they subjected it was sufficient to disengage it entirely.

However, we must own that it is still possible to find alums containing ammonia, but they must be extremely rare; for the method of saturating the aluminous solutions by urine has been but little known and used, because it is generally believed that this alkali injures the beauty of the dyes.

Fifth Experiment.

The presence of iron in alum had been demonstrated almost to a certainty by the analysis of Monnet, Bergman,

man, of Messrs. Chaptal, Vauquelin, and several other chemists who all regarded alums, even that of Rome, as salts perfectly identical, but that their properties might be affected by some foreign substances, and especially by sulphate of iron.

To appreciate its influence, it was necessary to ascertain the quantity that the alums were capable of containing; but the analytical means not being sufficiently exact for this purpose, Messrs. Thenard and Roard availed themselves of synthesis. They took some alum free from iron, to which they added successively, after having dissolved it, from $\frac{1}{100}$ to $\frac{1}{2000}$ of sulphate of iron, and they afterwards compared the precipitates which were formed with prussiate of potash in each of these solutions, more or less ferruginous, to those which it formed with the solutions of the five alums.

They found, by this method, that the alum of Liege contained at most $\frac{1}{1000}$ of sulphate of iron, that of Javelle a little less, those of Bouvier and of Carraudau, $\frac{1}{1600}$ or $\frac{1}{1700}$, and that the quantity contained in the Roman alum scarcely rose to $\frac{1}{2000}$.

From all these experiments, the result was that the alums of Rome, Bouvier, Liege, Javelle and Curaudau contained strictly the same quantities of sulphuric acid, of alumine, potash and water, and that they only differ by some thousandths in the quantity of sulphate of iron they contain; and that a hundred parts are formed of

Sulphuric acid, - - - - - -	26,04
Alumine, - - - - - - - - -	12,53
Potash, - - - - - - - - - -	10,02
Water, - - - - - - - - - -	51,41
Total	100,00

SECOND

SECOND PART.

Experiments in Dyeing.

Having given in the first part of their memoir all the results of their analyses, Messrs. Thenard and Roard express themselves as follows at the commencement of the second part, which comprises all their experiments in dyeing. This part appearing to us not to admit of an extract, we thought it best to give it entire.

Being convinced, say the authors, by the preceding experiments, that the alums of which we have been speaking are formed of the same quantities of sulphuric acid of alumine, potash and water, and that they may be considered to a certain degree as identical, since neither one nor the other differ more than $\frac{1}{1000}$ of sulphate of iron, we should begin by ascertaining whether they really have such different effects in dyeing as are generally attributed to them. Desirous of preserving in this second part of our work the same precision as in the first, we have sought to remove all uncertainties that presented themselves, whether they occurred in the mixing of the colouring substances, whether from the variations occasioned by the time, or by the vessels appropriated to the application of the mordants, whether from the unequal quantities of liquid, or the greater or less degree of temperature in the colouring vessels.

As we wished to observe with the greatest care all the effects that could possibly occur in the course of our experiments, we have made the greatest part of them ourselves, and all the rest have been executed under our inspection in our own dyeing apparatus.

We have not offered to the Institute the results of more than five hundred experiments in dyeing that we have made,

made, and of which the greatest part have merely served just to clear our way, or to confirm facts with which we were already acquainted. All those which we have suppressed would have added nothing to the multiplied proofs that we have collected under our eyes.

All these researches were made at the dyeing works at Gobelins; we could not choose an apparatus more convenient, and which presented more advantages; for the continual works carried on there, which are destined to supply the three Imperial manufactures enabled us to make very numerous and various experiments, without interrupting them, which we could not have executed elsewhere, except at a considerable expense; there we found every convenience that was requisite for our purpose, and we had besides the assistance of an experienced dyer in M. Bloudeau, the chief manager of the works, who adds to a great skill in colours the knowledge of a very extensive practice.

First Article.

Comparison of the Effects produced by Dyeing with the Alums of Rome, Bouvier, Liege, Javelle and Curaudau.

The first subjects that we employed, in operating upon these five alums, were wool, silk, thread, and cotton; we applied to each of them, according to their natures, all the preliminary preparations adopted in the most noted dyeing works. Knowing the great use made of calicoes for the fabrication of printed or coloured cloths, and that the Roman alum is used exclusively for all the delicate colours, we were desirous of making some applications that would enable us to decide on this subject. We therefore had recourse to M. Davilliers, who very obligingly made comparative trials, in his manufactory at Wesser-

Wesserlingues, of the five alums, which had been submitted to our experiments. The samples which he remitted to us coincided very well with all our results; but, as very plausible objections might be made to the unequal application of the mordants, we sought to anticipate them by adopting yet another method, that of dyed cloths.

M. Berthollet, the son, who has already been occupied with success, both in the science and its applications, especially in those which relate to coloured cloths, which he has studied with much care on the beautiful manufactory of Jouy, was very willing to come and direct us in this very important part of our work, and to assist us in all our researches on this subject.

Each of the experiments which compose this article were made with the alums of Rome, Bouvier, Javelle and Curaudau.

Woollens.

1st Experiment, the yellow woad.
2d ———— cochineal.
3d ———— madder.
4th ———— kermes.
5th ———— *orseille.*

Thread.

6th Experiment, yellow of woad.

Spun Cotton.

7th Experiment, yellow of woad.
8th ———— madder.
9th ———— sumac.

Calicoes.

10th Experiment, yellow of weld.
11th ———— madder.
12th ———— sumac.

Silks with the five Alums.

13th Experiment, woad.

14th ———— crimson.

Silks with the Acetates proceeding from the five Alums.

15th Experiment, woad.

We see by these experiments that the alums of Rome, Bouvier, Liege, Javelle and Curaudau, generally act in the same manner upon woollens; that the effect is something different upon cotton; and that they produce a great difference in silk. Therefore, these alums contain exactly the same proportions of the same principles; and that they do not vary in more than $\frac{1}{1000}$ of sulphate of iron: we are therefore forced to conclude that the differences which we have related must be attributed to this $\frac{1}{1000}$ of sulphate of iron.

The following are the experiments we have made to prove this fact.

Second Article.

The Alums of Rome, Bouvier, Liege, Javelle and Curaudau, in their ordinary State, compared with the same Alums when purified.

Having deprived these five alums of all the iron that existed in them, we made comparative experiments on them, thus purified, with that of Rome and those of French manufacture.

We at first made use of prussiate of potash to precipitate the iron; but, as this method was tedious and expensive, we substituted the more simple and well-known process of dissolving alums by boiling water, and of washing the pulveriformed crystals with cold water.

By this means we separated all the sulphate of iron from the most impure alum, on which then the prussiate of

of potash had no sensible effect, even when it had been exposed to the air for several days. But so perfect a purification would be entirely useless in the arts.

Woollens.

16th Experiment, yellow of woad.
17th ———— cochineal.
18th ———— madder.
19th ———— kermes.

Thread.

20th Experiment, woad.

Spun Cotton.

21st Experiment, woad.
22d ———— madder.
23d ———— sumac.

Calicoes.

24th Experiment, woad.
25th ———— madder.
26th ———— sumac.

Silks.

27th Experiment, woad.
28th ———— cochineal.
29th ———— *fustet.*

Upon woad and cochineal, which are the two colouring substances on which sulphate of iron has the most effect, the purified alums produced colours more brilliant and rather more clear, while those of the usual alums were all more dull and very sensibly of a deeper tinge.

This slight augmentation in the intensity of the colour proceeds only from the small quantity of iron which is found in our ordinary alums. To be assured of this, we added to our pure Liege alum, containing no sulphate of iron, some portions of this substance that were scarcely appreciable,

appreciable, afterward more and more by degrees; and in thus returning to it, all that it had lost by the purification we transformed into the alums of Rome, Bouvier, Curaudau and Javelle, successively; and at last we returned it to its original state of Liege alum.

Third Article.

Comparison of the Alums of Rome, Bouvier, Liege, Javelle and Curaudau, in the ordinary State, with the same Alums, after the Addition of increasing Proportions of Sulphate of Iron.

We were satisfied that the slight variations produced by these different alums in dyeing, were owing to the different and scarcely appreciable quantities of sulphate of iron which they contained; but, to remove at once all the doubts that might still be started on this subject, we confirmed by synthesis all the facts which the analysis presented to us.

Woollen, thread and cotton were alumed in pure alums, and in the same alums to which had been added $\frac{1}{100}$, $\frac{1}{50}$, $\frac{1}{25}$, $\frac{1}{12}$, $\frac{1}{6}$, $\frac{1}{3}$, of their weight of sulphate of iron, and with this sulphate pure.

The silks were also alumed in the same proportions in the five preceding alums, and with pure alum, to which had been added from $\frac{1}{1000}$ to $\frac{1}{100}$ of sulphate of iron.

Woollen.

30th Experiment, woad.
31st ———— ditto.
32d ———— ditto.
33d ———— cochineal.
34th ———— ditto.
35th ———— ditto.

36th Experiment, madder.

37th ———— ditto.

38th ———— ditto.

39th ———— kermes.

40th ———— ditto.

41st ———— ditto.

42d ———— prussiate of potash.

Thread.

43d Experiment, woad.

Cotton.

44th Experiment, woad.

45th ———— madder.

46th ———— sumac.

Calicoes.

47th Experiment, woad.

48th ———— madder.

49th ———— sumac.

Silks.

50th Experiment, woad.

51st ———— cochineal.

52d ———— *fustet.*

Silks.

53d Experiment, woad.

54th ———— cochineal.

55th ———— *fustet.*

56th ———— woad.

57th ———— cochineal.

TO BE CONCLUDED IN OUR NEXT.

List of Patents for Inventions, &c.

(Continued from Vol. IX. Page 440.)

ROBERT VAZIE, of the parish of St. Mary, Rotherhithe, in the county of Surrey, Civil Engineer; for improvements in the measures, and in the machinery to be used in making bricks and earthen-ware, and also improvements in the carriages for removing the said articles. Dated November 6, 1806.

JAMES ROYSTON, of Halifax, in the county of York, Card-maker; for an improvement on the system of card-making, by a method of cutting teeth for carding of wool and tow. Dated November 6, 1806.

JOHN WILLIAM LLOYD, late of Brook-street, Grosvenor-square, in the county of Middlesex, but now of Bishop Wearmouth, in the county of Durham, Esquire; for anti-friction rollers or wheels to assist all sorts of carriage-wheels. Dated November 20, 1806.

JAMES HENCKELL, of the city of London, Merchant; for certain improvements on a machine for dressing coffee or barley, or any other corn, grain, pulse, seed, and berries. Communicated to him by a certain foreigner residing abroad. Dated November 20, 1806.

WILLIAM NICHOLSON, of Soho-square, in the county of Middlesex, Gentleman; for various improvements in the application of steam to useful purposes, and in the apparatus required to the same.
Dated November 22, 1806.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LVI. SECOND SERIES. Jan. 1807.

Specification of the Patent granted to Edward Heard, *of London, Chemist; for a Discovery of certain Means of obtaining inflammable Gas from Pit-Coal in such a State, that it may be burned without producing any offensive Smell.* Dated June 12, 1806.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Edward Heard do hereby declare that my said invention is fully described and ascertained as follows; that is to say: I stratify the lime with the coals in the retort stove or other close vessel, in which they are placed for operation, or suffer the gas when produced to pass over lime previously laid in an iron or other tube, or any other shaped vessel adapted to the purpose, and expose it to heat. After the gas has been conducted into a refrigeratory, and all condensible matter is deposited, it is then suffered to enter the conveying tubes, and burned in the usual manner. My reason for employing lime for this purpose is, that, from a series of analytical experi-

ments, I have detected the presence of sulphur in a great variety of the coals which are consumed in this country; and as I consider the suffocating offensive smell so perceptible during the combustion of the gas obtained in the ordinary way, to arise from the products of that combustion, principally the sulphureous acid gas which is then generated; I present lime in substance to the sulphur as it is disengaged by heat from the coals, and through their mutual affinity arrest it in its progress, and form a sulphuret of lime or hydro-sulphuret depending on the circumstances of the operation. I have reason to conclude that any of the fixed alkalies or alkaline earths, such as barytes, strontian, and other similar earths, or carbonate of lime, when exposed to a degree of temperature sufficient to drive off the carbonic acid gas, might be substituted for lime; but from economical motives as well as constant success I prefer the agency of lime. It must therefore be clearly understood that lime in substance or a dry state, the fixed alkalies or earths possessing alkaline properties, or such metals or their oxyds as possess a sufficiently strong affinity with sulphur and sulphurated hydrogen as to answer the end desired, such as iron, manganese, zinc, copper, lead, &c. when mixed with the coals, laid on their surface, or put into separate vessels through which the gas is made to pass, are calculated in a greater or less degree to divest the gas of the cause of the offensive smell; but I distinctly state that I have always found lime (if caustic the better) stratified with coals and exposed to heat, the most economical and successful process.

In witness whereof, &c.

Specification

Specification of the Patent granted to ROBERT NEWMAN, *of Dartmouth, in the County of Devon, Ship Builder; for his Improvement in the Form, Formation, and Construction, of Ships and other Vessels of War, and of Ships and other Vessels of Commerce; and of Sloops, Barges, and other Vessels any other ways employed.*

Dated September 6, 1806.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said Robert Newman, in pursuance of the intention of the said letters patent, and in compliance with the said proviso therein contained, do hereby declare and make known that my said invention and improvement consists in, and extends to, the following matters, collectively or separately taken;—First, an apparatus or helm containing two rudders, formed and worked in the direction of the sides, in lieu of one placed in the centre line of the vessel, by which bodies of the greatest capacity may be governed, guided, or steered, wore and stayed with greater certainty, ease, and safety. Secondly, in a concave or hollow form of side and bottom that will make vessels of a light draught of water keep a better wind, carry more sail, and roll less. Thirdly, in an inverted reduction of capacity toward the stern, commonly called the run, by which the resistance is lessened, without the stability or power of carrying sail being diminished by external construction; the whole of which will, from the following description and annexed drawings, be readily understood and easily executed.

Figs. 1, 2, and 3 (Plate IV.) represent views of the afterpart of a Thames barge or vessel of the most capacious form in general use, with an ordinary rudder R, fixed in

 the

the centre line of the vessel; in which situation it requires a magnitude that renders it both incommodious and dangerous, and even inadequate to its purpose, without the loss of all that capacity contained within the triangles A C B fig. 1, B A C fig. 3, and B D C fig. 2; whereas, if placed at B, figs. 2 and 3, it might be reduced to one half, and if removed to C, fig. 2, to one-fourth part of its present dimensions with increased effect, its power being not only greater by projecting into more active water, and meeting the current in its undiverted course, but also increased by its relative distance from the centre line A O, fig. 2, of the vessel's progress; whereas, a rudder fixed in the direction of the line A O, fig. 2, acts only by the obliquity of its opposing surface E A, fig. 2, or when placed perpendicular to the line A O, fig. 2, or direct athwartships, tends but to obstruct, not alter the course of the vessel. A *a b c* and C, fig. 2, shew the rudders at those places with their proportional reductions, and exhibit the different situations, in which they may be fixed for convenience in particular services.

Fig. 3 represents an oblique view of figs. 1 and 2, with the rudder at A, fig. 2.

Fig. 4, represents a like view with rudders placed at B and A, figs. 2 and 3, respectively; with the triangle C D E, fig. 3, at each side instead of the centre.

Fig. 5, represents the same view with the rudders placed at C, fig. 2; the extremity of the breadth without any contraction horizontally or vertically of the vessel's capacity.

The manner of working a helm of this description must depend much on the nature, size, and service of the vessel. It may act outwards or either way, be without or inclosed within the stern and side, above or below the deck, and moved by one wheel, winch or other engine placed

amidships

amidships or elsewhere, and connected by chains or ropes in the ordinary way with a short iron lever projecting from each rudder, the length of which need not exceed a sixth part of the tiller required for the common rudder. In this manner I found by an experiment tried on a temporary form of not less than one hundred and fifty tons burthen, constructed by me for the purpose about four years since, that a single man or boy could not only steer with the greatest ease, but manage at the same time the largest sail of the vessel, in an open and rough sea.

Fig. 6, represents the transverse or thwartship section of a vessel whose sides and bottom are an inversion of the ordinary form, curving outwards, and extending down to a level with the under-part of her keel, opposing by their extent and shape the greatest resistance to a lee course with less tendency to roll or upset, and presenting at the same time a stronger surface to the pressure of the cargo or weight within the ship. Resistance to leeway may also be increased, by ribbing or indenting the coat of the side with projecting or binding planks, that obstruct in a side direction, only while they strengthen the vessel and protect the caulking, see figs. 7, 8 and 9.

Figs. 10, 11 and 12 represent fig. 6. and two ordinary forms in an inclined position, or that situation in which vessels are most impelled to leeward, by which it may be seen that fig. 10 in this position increases its draught of water and consequent resistance to leeway by the side descending from B to C, in addition to its concave surface.

Fig. 11, represents an ordinary form of burthen that neither increases or decreases its draught of water by inclination, but loses the effect of its keel; and fig. 12 shews a common sharp form, whose draught of water decreases from A to D, and lessens its resistance when most required. It may also be seen that, did their draught of

water

water continue the same, fig. 10 would, moving in the direction from B to A, meet with greater resistance than either of the other forms.

Figs. 13, 14 and 15 exhibit a vessel, whose sides are either perpendicular and parallel planes or concaves from the foremast to the aftermast extremity, whose horizontal sections A B C D, fig. 14, are at every height exteriorly alike, possessing each the greatest possible expansion, and whose capacity abaft is internally contracted to a form resembling a swallow's tail, by which the vessel derives the accelerating impulse from the closing volume of water, without that loss of stability or power of carrying sail inseparable from external contraction, the stability of a vessel not depending on her length and breadth at one particular point, but on the aggregate of their extension; and an ordinary vessel's stability is confined nearly to her midships, see B, fig. 16; for, were the fore and after-parts A and C, disengaged from B, they would be incapable of maintaining their position, as must appear from a view of fig. 16, the horizontal section of an ordinary vessel. The greater facility too with which this form, fig. 16, must move to leeward is also apparent, as well as its tendency to pitch and ascend from want of expansion at the fore and aftermost extremities. The form of the bow, fig. 14, may be contracted to the dotted lines E and F, though I do not conceive the angles would retard the vessel's progress, the power acquired by them being equal to the resistance they would meet. The forms which are here given are confined to such parts of the vessel as are below the lead water-line, being limited to the active or immerged substance, and capable of being executed by ordinary modes of workmanship. The form above, or the upper works, may be varied and fashioned at discretion. In witness whereof, &c.

Specification

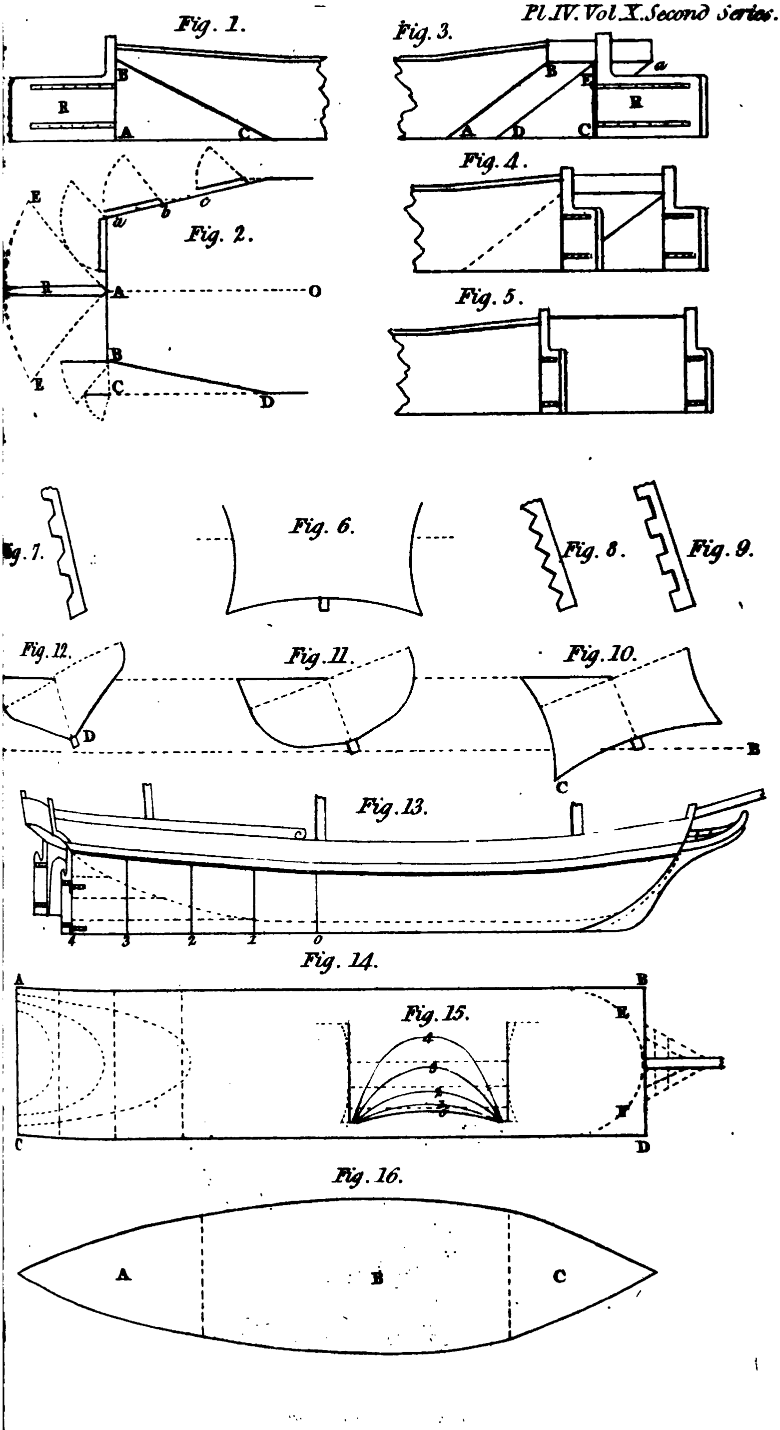
Fig. 1.
R
B
A
C
Fig. 2.
E
a
b
c
R
A
O
B
C
D
E
Fig. 3.
B
E
a
R
A
D
C
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.
Fig. 9.
Fig. 12.
D
Fig. 11.
Fig. 10.
C
B
Fig. 13.
4
3
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Fig. 14.
A
B
C
D
E
F
Fig. 15.
Fig. 16.
A
B
C

Specification of the Patent granted to William Clarke, *of Cerne Abbas, in the County of Dorset, Clock-maker; and* Joseph Bugby, *of Yeovil, in the County of Somerset, Schoolmaster; for Improvements in a Machine for spinning Hemp, Flax, Tow, and Wool.*

Dated June 19, 1806.

With a Plate.

TO all to whom these presents shall come, &c. Now know ye, that we the said William Clarke and Joseph Bugby, in compliance with the said proviso in the said letters patent contained, and the purport and true intent and meaning thereof, and of his Majesty's said most gracious intentions, do, by this instrument of writing under our hands and seals duly executed, describe, and ascertain the nature of our said new-invented spinning machine, and the manner in which the spinning is to be performed, according to the plan or drawing thereof in the margin of these presents, in manner and form following; that is to say;

Fig. 1 (Pl. V.) represents an oblique view of the front of a frame containing ten spindles (but frames may contain an indefinite number of spindles). A, a spindle or a bow passing through the whole frame, having ten bosses of brass or cast iron thereon, each about 4 inches diameter, each boss supplying one spindle; B, a pinion of 12 upon the end of the spindle A, connected with the wheel C, of 80 teeth, fixed upon the end of a small iron spindle F, covered with wood and extending through the whole frame, D, a slack or intermediate pinion of any size at discretion, connected with another similar pinion, the

the latter connected with the wheel E of 120 teeth, which is fixed upon an iron spindle G, of about an inch and a half diameter, and extending through the whole frame; but the wheels B C D and E may be varied in their numbers, to increase or diminish the draught of the substance operated upon, as may best suit its quality, or the ideas of the workman. The pinion B is so contrived as to slip off the end of the spindle A to make room for a smaller or larger one; by means whereof a larger or shorter thread may be spun from the same sized rovings. *a a a a a a a a a a* represent ten roved slivers of hemp, flax, tow, or wool, passing between the iron spindle G and rollers in pairs pressed against them by springs or weights; these springs or weights must be of sufficient force to hold back the slivers or rovings so securely, that they may only pass on with the movement of the spindle; these pairs of pressing rollers are placed behind the spindle. The use of the small iron spindle F covered with wood, and left rather larger than the spindle G is, with pressure of the small wood roller, made up in pairs *b b b b b*, and so contrived that each pair may roll upon two slivers, to bring them down straight, and preserve the twist which they receive in the roving machine till the slivers leave them. The bosses on the spindle A have likewise wood rollers in pairs pressed against them by springs or weights, between which the drawn, lengthened or extended slivers pass to the spindle, the rollers having each a tin conductor marked *c c c c c c c c c c*, to bring the material under operation as centrically as possible between the wood rollers and the bosses; but all the above-mentioned part of the machine is so similar to the common upright frames for spinning flax, that a person conversant with them will not be at a loss to make it all. H is a wheel of wood 4 feet diameter, having its rim about 2 inches thick, with a

grove

grove in its periphery for a small cord or band. In its centre is a nib or stock of wood through which the spindle I passes, and extends into its frame about one-fourth of its length. To enable the person that turns the winch K to reach all the spindles at work, with the hand that is not engaged in turning, to remove any obstacle that may arise to the spindles; the arbor or spindle of the wheel I has its bearing on the sides of the frame that contains it, marked L L L L; this frame with the wheel H, the arbor I and the winch K, are similar to that part of a machine called a mule jenny, used for spinning cotton; this frame is supported in a horizontal position at the outer end by two logs marked M M, and a screw pin which paſſes through the front upright *a* A, fig. 2, and made tight with the thumb screw *a*; the screw passes through a groove or mortise at the end of the wheel frame, to enable the workman to adjust the wheels N and O, as it will be found necessary to change the wheel N, to make such alteration in the twist as the size of the yarn may require, or as the workman may think proper. P and Q are bevel wheels of equal size, the former fixed upon the nib or stock of the wheel H, and connected with Q upon the spindle R, taking round with it the wheel N, which is connected with the wheel O. Upon the bossed spindle or arbor A, *d d d d d d d d d d*, are spindles standing in a carriage of four wheels, similar to the carriages used in mule jennies for spinning cotton, having at each of them at *d d d d d d d d d d* a convex seat of wood of any convenient size, not less than the bottom of the bobbins or quills *e e e e e e e e e e*; these bobbins or quills are about six inches long, and an inch and a quarter diameter at the bottom, and three quarters of an inch diameter at the top; but the sizes must be varied according to the size of the yarn. Perhaps four or five variations will be sufficient to spin yarn for tarpolins and sail cloth, up to fine yarn, fit for good dowlas

and fine tickings. T a pulley, over which a band from S runs and returns to draw out the carriage upon the four wheels above described. W the cylinder which drives the spindles.

Fig. 2, exhibits a side view. A the wheel mentioned above in fig. 1, and there marked H; B the winch by which it is turned by hand; C C C C the frame wherein it works; D and E are blocks of wood in each side of said frame to raise the wheel, so that the winch may be clear of the carriage F F, and apparatus G G; the two end wheels upon the carriage containing the spindles having two more corresponding on the opposite side thereof. H, a groove wheel upon the end of a cylinder, which drives the spindles, and stretches through the carriage frame, for the diameter of which no certain rule can be laid down, as it depends on the length or size of the yarn taken into account with the other parts of the machinery. N N N N N N N, a small band passing over the wheels A K, H I L and M, by which the groove wheel H and its cylinder are moved, and the spindles driven. O a trendle shaft represented by S S in fig. 1, passing through the frame or part thereof at the option of the workman, connected with a tumbler on the end of the bossed spindle or arbor A, in fig. 1, by a small band, wound five or six times round each of them, and passing over the wood groove wheel Q, and made fast to the back of the carriage F F; this tumbler, by the motion of A, is, at the return of the carriage, locked to the wheel R, and unlocked when the carriage is not to its destined place.

The carriage is drawn in by the weight of S fastened to a cord, which passes over the groove wheel T, and is connected with the front of the carriage, U the wheel on the arbor containing the holders shewn in fig. 1. V the cylindrical roller on a stirt fixed therein, and rolling at every return of the carriage upon the plane W and

and X, which raises and falls the fallers and holders, so as to distribute the yarn upon the bobbins from top to bottom; the wheels Y Z, A 2 and B 2 are the same wheels shewn by B, C, D and E, in fig. 1. 1, 2, &c. spools containing the rovings.

This machinery is calculated to save the heavy expense of currents of water, erecting spacious buildings, water-works, steam-engine, &c. and to spin hemp, flax, tow, and wool, at such an easy expense, as to bring it within the reach of small manufacturers, and constructed upon such safe and easy principles, that no length of experience will be necessary to enable children to work the same; and the use of water, steam, &c. thereby rendered unnecessary and to occupy so little space, that the machines may be placed in small rooms, out-buildings, or other cheap places. To effect the above purpose, it was necessary to get rid of the lanier or flyer upon the spindle used in the old machinery for spinning hemp and flax, which requires a power in proportion of five to one, and to surmount the difficulty that arises from the want of elasticity in these substances. This want of elasticity in the substance to be operated upon is compensated and provided for in this machinery; and upon this compensation and provision, effected by the various means hereinafter mentioned, the return of the carriage without any assistance from the work person, and the traverse for distributing the yarn upon the bobbins or quills, lay the stress of our patent. The most simple mode of compensating the want of elasticity, and which we recommend in preference to the other, is that of having a holder of large wire for every spindle fixed in an arbor or shaft that extends from one end of the carriage to the other.

This arboror shaft, with the holders, may be considered as an enlarged and improved substitute, for what is called

 a faller

a faller in the moll jennies for spinning cotton, see fig. 3. Let A represent the arbor or shaft *b b b b b b b b b b*, the holders fixed therein with their eliptical eyes, through each of which a thread passes from the bosses on the arbor A, in fig. 1, to its spindle. B, a spindle, which may be from 10 to 13 inches long. C, the whirle wherein a small worsted band from the cylinder H, fig. 2, works D, a convex seat upon the spindle, whereon the concave bottom of the bobbin or quill E rests. F a piece of buffalo skin or metal screwed or nailed to the rail I, having a hole in it, through which the spindle passes, and by which it is kept steady; G, a wire bent at right angle at *a*, and the bent part driven into the rail A, so that it may be removed to or from the whirle C, and by the other crook *b*, prevent the spindle from running out of its step H, which is a screw of brass or other metal passing through the rail K. The wire of which the holder is made, after forming the eliptical eye, is left or extended beyond the uppermost part at *c*, that the yarn may be conveniently slipped in when occasion may require it; these holders for each thread are for the purposes of keeping the yarn in a state nearly vertical over the tops of the spindles where the carriage which contains them is coming out, and being released from that situation at the beginning of the carriages return, and thrown into nearly a horizontal position, so as to bring the yarn below the tops of the bobbins or quills upon the spindles; and then being curved and raised again by the wheel U, and its cylindrical roller moving upon the plane W and X, fig. 2. distributes the yarn upon the bobbins or quills, and prevents it from corkling, hinkling, or improperly doubling or twisting together. The seats upon the spindles described by D, are turned convex, and the bottoms of the bobbins and the bottoms of the quills concave, to keep the bobbins or quills in a more central state upon the seats.

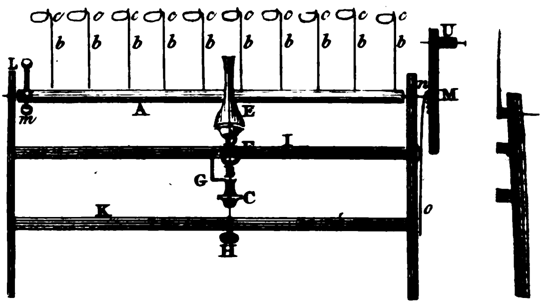
The

The concavity of the bobbins or quills exceeding the convexity, throws the weight of the bobbins or quills upon the peripheries or extremities of their seats, and insures the rotary motion of the bobbins or quills with that of the spindles. We prefer the convex and concave surfaces before described; but other surfaces will have nearly the same effect, if so contrived (as they easily may be) to bear upon the peripheries or extremities of the seats as well as of the bobbins or quills. The hole through the bobbin or quill, fig. 4, is rather larger than the spindle, that it may not be obstructed in its motion round the spindle, which motion takes place at every return of the carriage, and as often as any thing obstructs the coming forward of the sliver of which the yarn is formed. At one end of the arbor whereon the holders are fixed is a counterpoise L, fig. 3, having a socket, and made fast. The arbor by a thumb-screw *m*, the round ball at the top being lead to counterbalance the holders. This counterpoise, when the holders are in a vertical state, declines about ten or fifteen degrees towards the horizon, but when the holders are thrown down, and under the government of the cylindrical roller V, upon the wheel U, is in a different situation; but the roller V arriving at B 3, fig. 2, on the return of the carriage, the holders are precipitated to a height where the counterpoise overbalances them, and locks the wheel M, fig. 3, or U, in fig. 2, in the ratchett *n*, where it remains till the carriage has reached its destined place, where the tail of the catch O strikes against a pin in the frame C C C C, fig. 2, and releases it, the said roller then resting upon the plane U X.—Our second method of compensating and providing for the want of elasticity in hemp and flax, which is part of our discovery, is, to fix a round bar of wood, about an inch and a half diameter, the whole length of the carriage, about

about 3 or 4 inches above the tops of the spindles, so that the outer surface or that next the work person may be perpendicularly or nearly so over the tops of the spindles, the inner side having pieces of wood or metal nailed or otherwise fixed thereto, leaving only small spaces between each for the yarn to pass through; the use of these pieces is to prevent the threads from getting together and intangling, see fig. 5. A A A A, represents a common faller used in the mule jennies for spinning cotton with counterpoise B, wheel C, with its cylindrical roller D, with the plane W and X, before described by fig. 1, 2. and 3. EE, spindles with their whirles, convex seats, bobbins or quills, with their concave bottoms, F F F F F F F F F the pieces of wood or metal, nailed or otherwise fastened to the round bar of wood to prevent the threads getting together. In this case every thing applied to or used with the arbor, containing the holders abovementioned, may be applied or used.—Our third method of compensating the want of elasticity in hemp and flax, which we specify also as a part of our contrivance, invention, and discovery, is by means of fixing each spindle in a small frame A A, fig. 6; *b*, a step of brass; C, a common-made spindle with its whirle D; E and F two stirts of iron fixed one on each side of the frame A A, equally in a line with the groove in the whirl D, and moving in holes in two checks *g g*, fastened into the rail H, on the small frame A A. On the back side thereof, next to the cylinder, is a small roller moving upon two pivots, so planted, that when the spindle is in an upright position, the band from the cylinder which drives it may run just free of it, and as the spindle frame A A, is kept to the rail I, by a tender spring made of wire, wound round a pin about half an inch diameter, that the spindle may yield to the yarn in all cases when necessary, the

...cond Series.

Fig. 3.



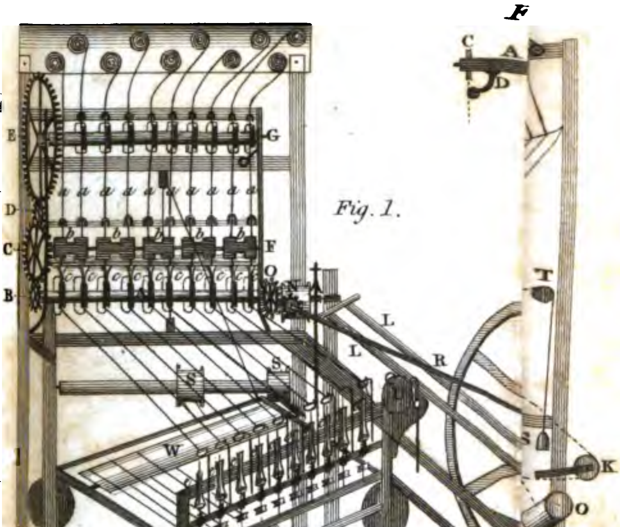


Fig. 1.

the said roller is to prevent the band which drives the spindle out of the whirle, when the spindle leaves its vertical position.

Fig. 7, a side view of the little frame in fig. 6; A, the frame, B the spindle, C the whirle therein, D the end of the roller and one of its supporters. This apparatus requires the faller last-mentioned and described by fig. 5, with its appendages for laying the yarn upon the spindles, no seat on the spindle or bobbin in this case being wanted, nor any more than a piece of paper or something thin round the spindle, to enable the spinner to take the yarn off with safety and care. Our fourth and last-mentioned mode of compensating and providing for the want of elasticity in hemp and flax, and prevent breakages and other accidents from any tightness in the yarn, occasioned by any obstruction or other circumstance, and which is part of our invention and discovery; is by driving the common mule spindle with a slack band having the yarn to pass over the holders described in fig. 3, or over the round bar described in fig. 5, with all the other apparatus for laying the yarn upon the spindles, &c. This last method cannot be used to advantage in any case, but may be substituted for either of the three methods described above for spinning yarn for sail-cloths, sackings, tarpolins, or other coarse or heavy goods. By spinning wool we wish to be understood, that the machinery above specified may be used to great advantage in spinning long wool for worsted; and, although this machinery is peculiarly adapted to manual power in most cases, yet it may be wrought by water, steam, or any other power, and for coarse and heavy goods perhaps with some advantage; and all the above contrivance, invention, and discoveries, have been put in practice by us.

In witness whereof, &c.

Specification

Specification of the Patent granted to RICHARD CLARKE, *of Manor Street, in the Parish of Saint Luke's, Chelsea, in the County of Middlesex, Paperhanging Manufacturer; and* THOMAS FRICKER, *of New Bond-street, in the Parish of Saint George, Hanover-square, in the County of Middlesex, Paperhanger; for a new Mode of decorating the Walls of Apartments, in Imitation of fine Cloth, without Joint, Seam, or Shade, by Means of cementing of Flock on Walls of Plaster, Wood, Linen, or Paper.*

Dated August 1, 1806.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Richard Clarke do hereby declare, that the said invention is described and performed in the manner hereinafter mentioned; that is to say: the said invention is a method of decorating the walls of apartments, in imitation of fine cloth of various colours and mixtures of colours, on the walls of apartments of plaster, wood, linen, paper, or any composition, without joint, seam or shade, or the appearance of any joint, seam or shade, throughout the whole room; and is performed in the following manner: The walls are first prepared for the reception of the flock by being pumiced smooth and even, and then washed wholly over with strong size and suffered to dry, a second coat of size is then put on, stained with the colour of which the flock is intended to be. A mixture consisting of one part of the mastic or composition made in the manner after described, and three parts of colour the same as the flock intended, ground in oil well boiled together, must then be put on the walls by means of brushes over the second coat of size, which should be per-

perfectly dry, very smooth, and even; after which the flock is to be thrown on whilst the latter composition or mastic is wet, by means of an apparatus, consisting of a receiving box to hold the flock, with bellows at top and bottom on one side, to force out the flock through a hole in the centre of the opposide side of the box, and also with a machine similar to that used for hair powder (except that the aperture at the small end is open instead of having gauze or wire before it) to be used occasionally, whereby the flock is attached to the walls in every part required, care being taken that it is thrown smooth and equal in all parts; when dry it bears the appearance of fine cloth, and is equally close, firm, and strong. The mastic or composition above-mentioned is made in the following manner: to one gallon of linseed oil, and one gallon of spirits of turpentine, add one pound of gum-anima; boil them well together until of the consistency of tar. The flock is composed of the refuse or cuttings of woollen cloth or of cotton or silk, previously dyed the colour or colours desired.

In witness whereof, &c.

A Third Series of Experiments on an artificial Substance, which possesses the principal characteristic Properties of Tannin; with some Remarks on Coal.

By CHARLES HATCHETT, *Esq. F. R. S.*

(Concluded from Page 34.)

§ V.

IN my first Paper I have remarked, that I suspected the tannin of the peat moors to have been produced during the imperfect carbonization of the original vegetable

 sub-

substances. Whether this has been the case, or whether the tannin has at times been afforded by heath and other vegetables growing upon or near the peat, still appears to me to be uncertain; but whatever may be the origin, I never have yet been able to detect any tanning substance in peat, although I have examined a considerable number of varieties, some from Berkshire, and many from Lancashire, which were obligingly sent to me for this purpose by my friend John Walker, Esq. F. R. S. Mr. Jameson has also made the same observation *, so that there cannot be any doubt (whatever the origin of the tanning matter may have been) that it has speedily been extracted and drained from the substances which at first contained it.

This effect is a natural consequence of the great facility with which tannin is dissolved by water, and extends even to the most solid vegetable bodies; I shall here give an example.

In the Philosophical Transactions for 1799, Dr. Correa de Serra has given an account of a submarine forest at Sutton, on the coast of Lincolnshire, where submerged vegetables are found in great abundance, including trees of different descriptions, especially birch, fir, and oak. At the time when I was engaged in those experiments on the Bovey coal, and other substances of a similar nature, which have been printed in the Philosophical Transactions for 1804, Sir Joseph Banks had the goodness to send me a piece of the oak, which was perfect in all of its vegetable characters, and did not appear to have suffered any change, excepting that it was harder, and of a darker colour than recent oak wood. From some experiments which I then made, I found, that after incinera-

* An Outline of the Mineralogy of the Shetland Islands, &c. 8vo. edition, p. 174.

tion

tion it afforded potash, similar to the recent wood, and contrary to substances like the Bovey coal, which retain the vegetable external characters, although imperfectly converted into coal *.

In the course of my experiments on tannin, I reduced about an ounce of this submerged oak into shavings, and digested them in water. A brown decoction was formed, which with muriate of tin afforded a pale brown precipitate; with acetite of lead, a precipitate of a deeper brown; with sulphate of iron, a copious brownish-black precipitate; but with solution of isinglass not any effect was produced.

The tannin of this oak wood had therefore either been separated by solution, or had been decomposed; so that the only substance which remained capable of being dissolved by water, was the extractive matter. This last, in the present case, was most probably the original extractive matter of the oak, but in some other instances, (such, for example, as that which was found in the alder leaves contained in the Iceland schistus †), I am much inclined to believe, that an extractive substance of secondary formation, if I may be permitted to employ such a term, is produced during the process of carbonization. If a substance, therefore, so compact and solid as oak timber can by long submersion be deprived of its tannin, it naturally follows that the same effect must be more speedily produced by the action of water on the smaller vegetable bodies, which present an extensive surface, and also on porous and bibulous substances such as peat.

But although peat, as I have already observed, does not contain any tannin, yet the imperfect carbonization

* Phil. Trans. for 1804, p. 399.

† Ibid. p. 391.

which it has undergone, renders it, like the roasted ligneous bodies, peculiarly susceptible of being converted into the artificial tanning substance, when exposed to the action of nitric acid. It would be useless to enter into a detail of the different experiments which I have made upon it, as they were similar to those already related; and I shall therefore only here state, that when seven ounces of well-dried peat had been twice moistened, and digested with diluted nitric acid, (to the amount of rather more than two ounces,) and subsequently dried, I obtained by water a solution of the artificial tanning substance, which, when evaporated to dryness, weighed two ounces. I am convinced, that much more might have been obtained from the residuum of the peat, had I thought proper to have repeated the operation; and I am also certain, that less nitric acid would have been sufficient, had the process been conducted in close vessels, and with other economical precautions, which at that time were for the sake of expedition and convenience omitted.

§ VI.

It has been generally stated, even by modern chemists, that the acids act but little, if at all, upon resinous substances.

The contrary has however been proved, not only in the three Papers upon the present subject, but also in some others which I have formerly had the honour to lay before this learned Society.

In my experiments on lac, printed in the Philosophical Transactions for 1804, p. 208, I have particularly endeavoured to shew, how powerfully the acetic acid acts upon resin, gluten, and some other substances; so that it may justly be regarded as a valuable agent in the chemical analysis of vegetable bodies. In this point of view, it is

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as a solvent to be the more highly appreciated, because it appears to dissolve the resins, &c. without affecting their respective qualities; and thus by proper precipitants, these substances may be separated from it pure and unaltered.

I am induced therefore to consider acetic acid to be the true acid solvent of the resinous substances, as it dissolves them speedily, without producing any apparent subsequent change in their natural properties.

Sulphuric acid also, almost immediately dissolves the resins, balsams, &c. and forms transparent brown or sometimes crimson solutions, the latter colour being most commonly characteristic of the balsams.

These solutions, however, are different from those made in the acetic acid, by not being permanent, for, from the moment when the solution is completed, progressive alterations appear to be produced in the body which is dissolved; thus turpentine is almost immediately converted into resin, then into the third variety of the tanning substance, and lastly into coal.

Without being under the necessity of adducing other examples, we may therefore state sulphuric acid to be a solvent of the resinous substances, but which continues afterwards to act on their principles, so as to decompose them, coal being the ultimate product.

Nitric acid, as I have shewn in the course of these Papers, and likewise on some former occasions, dissolves the resins, but the progress of its effects seems to be conversely that of sulphuric acid; in the latter case, solution precedes decomposition; but when nitric acid is employed, decomposition to a certain degree precedes solution; for it at first converts the resins into a pale orange-coloured brittle porous substance, then into a product, which apparently possesses the intermediate characters of vegetable

vegetable extractive matter and of resins, and lastly, this is converted into the first variety of the tanning substance, beyond which I have not been able to effect any change.

As coal therefore appears to be the ultimate effect produced by sulphuric acid upon the resinous bodies, so does the first variety of the tanning substance seem to be the terminating product afforded by the same when acted upon by nitric acid. This effect of nitric acid has been already amply discussed, neither does it appear necessary that I should here repeat the remarks which have been made on some of the simultaneous products, such as the vegetable acids; but amongst the effects produced by sulphuric acid, the coal which is formed seems to merit some attention.

§ VII.

After the tanning substance and the other products had been obtained from the resins, balsams, &c. which have been mentioned in the beginning of this Paper, the following proportions of coal remained *:

	Coal.
100 grains of Copal - - -	67 grains.
——— Mastich - - -	66
——— Balsam of Peru - -	64
——— Elemi - - -	63
——— Tacamahac - -	62
——— Guiacum - - -	58
——— Gum ammoniac - -	58
——— Amber - - -	56
——— Olive oil - - -	55

* The weight of the coal obtained from each of the above mentioned substances, was estimated after the complete separation of every other product, and after the moisture had been expelled by a red heat, in close vessels.

100

		Coal.
100 grains of Balsam of Tolu	-	54 grains.
———	Asa fœtida - -	51
———	Wax - - -	50
———	Dragon's blood - -	48
———	Benzoin - - -	46
———	Olibanum - - -	44
———	Myrrh - - -	40
———	Asphaltum - -	40
———	Gamboge - -	31
———	Elastic bitumen - -	31
———	Gum arabic - -	29
———	Liquorice - - -	25
———	Manna - - -	25
———	Tragacanth - -	22
———	Caoutchouc - -	12*

The coal obtained from the resinous bodies by means of sulphuric acid, is in a much greater proportion, than when equal quantities of those substances are exposed to simple distillation.

For, (as I have stated in my first Paper,) 100 grains of common resin by the humid process afforded 43 of coal, which after a red heat still weighed 30 grains.

But the same quantity of resin by distillation, only yielded ¾ of a grain of coal.

100 grains of mastich, by the first method, afforded 66 grains of coal.

100 grains of the same mastich only gave 4½ grains of coal when simply distilled.

* Caoutchouc and elastic bitumen were only superficially carbonized by the sulphuric acid, so that the proportion of coal as above stated, is considerably less than that which in reality might have been obtained from them.

And

And 100 grains of amber, when treated with sulphuric acid, yielded 56 grains of coal.

But from 100 grains of the same amber when distilled, only $3\frac{1}{2}$ grains could be obtained.

Many other examples might be adduced, but these appear to be sufficient; and I must here observe, that the case is very different in respect to the gums, for the difference between the proportions of coal obtained from them by the humid and dry ways is not very considerable, although it is always the greatest in the former process, when conducted with precaution.. Moreover it is to be remarked, that in either process, variations in the quantity of coal are produced by difference of temperature, by the figure and size of the vessels, and many other circumstances.

But it is not only in the proportion, that there is so great a difference between the coal obtained from the resinous substances by the humid way or by fire, for the quality is also most commonly different; and this not only applies to the resins but also to ligneous matter.

The coal obtained by the humid process from many of the resins, was shining, hard, and occasionally iridescent. Few of the coals obtained from the same bodies by fire had any of these properties. The combustion of the former was slow, in the manner of some of the mineral coals, whilst on the contrary the latter were speedily consumed like charcoal. This difference I was at first inclined to attribute to a small portion of the acid which might not have been completely separated; and I therefore purposely made some experiments, which convinced me that this was not the case.

Having remarked this difference in the coals afforded by the resins, I was desirous to make some comparative experiments on wood; and for this purpose I selected oak.

1. On

1. On 480 grains of oak sawdust I poured two ounces of sulphuric acid diluted with six ounces of water, and placed the matrass on a sand-bath, where it remained from the beginning of last June to the end of September. During this time, the sand-bath had very seldom been heated, but the vessel was occasionally shaken.

At the end of the period above mentioned, six ounces of boiling water were added, and the whole being poured upon a filter, was repeatedly washed, and was afterwards dried on a sand-bath in a heat not much exceeding 300°.

The sawdust appeared to be reduced to a granulated coal, partly pulverulent, and partly clotted; the whole weighed 210 grains.

105 grains of this coal were put into a platina crucible, and were exposed to a red heat under a muffle. At the same time, an equal quantity of charcoal made from the same oak sawdust was placed in another vessel by the side of the former.

The charcoal was speedily consumed, and left some brownish-white ashes, which, as usual, afforded alkali, with a trace of a sulphate, which was probably sulphate of potash.

On the contrary, the coal formed by the humid way, burned without flame, similar to the Kilkenny coal, and others which do not contain bitumen. It was very slowly consumed, like the mineral coals above mentioned, and left some pale red ashes, which weighed 2 grains. These ashes *did not yield* the smallest vestige of *alkali*; and the only saline substance which could be obtained, was a very small portion of sulphate of potash, which did not amount to more than $\frac{1}{5}$ of a grain; and it is probable, that had the coal been more copiously washed, even this small portion of the neutral salt would not have been obtained.

2. At the time when the preceding experiment was begun, I also put 480 grains of the oak sawdust into ano-

 ther

ther matrass, and having added four ounces of common muriatic acid, the whole was suffered to remain during the period which has been mentioned.

At the end of the four months, the remainder of the acid was for the greater part driven off by heat not exceeding 300°. The sawdust then had the appearance of a brownish-black mass, on which about a pint of boiling distilled water was poured; the whole was decanted into a filter, was repeatedly washed, and was afterwards dried without heat. The sawdust then appeared, as I have observed, brownish-black, and was pulverulent. It burned with some flame, emitted still a slight vegetable odour, and was reduced to ashes much sooner than the coal formed by sulphuric acid, but not so speedily as the oak charcoal. The ashes had an ochraceous appearance, and were almost devoid of any saline substance, excepting a very slight trace of muriate of potash.

These two experiments therefore prove:

1st. That wood may by sulphuric acid be converted into a coal which in its properties is very different from charcoal, although prepared from the same sort of wood: and that the coal thus formed by the action of sulphuric acid, resembles by its mode of burning, and by not affording any alkali when reduced to ashes, those mineral coals which are devoid of bitumen.

2dly. That wood may also be converted into a sort of coal by muriatic acid, but in this case some of the vegetable characters remain, although, like the former, not any alkali can be obtained from the ashes.

§ VIII.

Four different solutions have been proposed respecting that difficult problem in the natural history of minerals, *the origin and formation of coal.*

The

The first is, that pit-coal is an earth or stone chiefly of the argillaceous genus, penetrated and impregnated with bitumen.

But Mr. Kirwan very justly remarks, that the insufficiency of this solution is demonstrated by Kilkenny and other coals which are devoid of bitumen, and also that the quantity of earthy or stony matter in the moist bituminous coals bears no proportion to the weight of them *.

The second and most prevailing opinion is, that mineral coal is of vegetable origin, that the vegetable bodies have, subsequent to their being buried under vast strata of earth, been mineralized by some unknown process, of which sulphuric acid has probably been the principal agent, and that, by means of this acid, the oils of the different species of wood have been converted into bitumen, and a coaly substance has been formed.

The third opinion is that of Arduino; who conceives coal to be entirely of marine formation, and to have originated from the fat and unctuous matter of the numerous tribes of animals that inhabit the ocean.

And the fourth is Mr. Kirwan's opinion, who considers coal and bitumen to have been derived from the primordial chaotic fluid †.

The limits of this Paper will not permit me to enter into the various arguments and facts which have been adduced in the support of these different opinions; but the second, or that which regards the vegetable substances as the principal origin of coal, seems by much the most probable, because it is corroborated by the greater number of geological facts, as well as by many experimental results. Most of the former have, however, been stated in different works, and I shall therefore only notice a few

* Geological Essays, p. 316. † Ibid. p. 327.

of the latter which have occurred in the course of my experiments.

The observations of Dr. Correa de Serra on the wood of the submarine forest at Sutton, on the coast of Lincolnshire, together with many similar accounts which have been published in the Philosophical Transactions and other works, demonstrate in the most satisfactory manner, that whether vegetables are totally or partially buried under the waves or under the earth, they are not merely by such means converted even into the most imperfect sort of coal *. Some process therefore independent of these circumstances must have taken place, in order that the vegetable substances, such as ligneous matter, resin, oil, &c. should become coal and bitumen.

In a former Paper I have endeavoured to shew, that these changes are progressive, and having noticed the perfect state of the submerged wood at Sutton and other places, I next described the qualities of the different kinds of Bovey coal, which exhibit a series of gradual changes from bodies which retain the vegetable structure and texture, although imperfectly carbonized, to others in which

* In my Paper, "On the Change of some of the proximate Principles of Vegetables into Bitumen," I have quoted the remarks of Bergman, Von Troil, and others, on the compressed state of the trunks of the trees which have been converted into surturbrand, Bovey coal, and similar substances. The same observation has been also made by Dr. Correa de Serra respecting the timber of the submarine forest at Sutton; and this is the more remarkable, as the submerged vegetables at Sutton do not exhibit any appearance of carbonization.

Dr. Correa says, "In general the trunks, branches, and roots of the "decayed trees, were *considerably flattened*; which is a phenomenon "observed in the surturbrand or fossil wood of Iceland, and which "Scheuchzer remarked also in the fossil wood found in the neighbour-"hood of the lake of Thun, in Switzerland." Phil. Trans. 1799, p. 147.

almost

almost the complete characters of the common mineral or pit-coal are absolutely established.

From the alder leaves in the schistus from Iceland, I obtained extractive vegetable matter, and although this was not afforded by the varieties of Bovey coal, yet these, as well as the alder leaves, and also a coal like that of Bovey, found in Sussex, at Newick Park, (an estate belonging to Sir Elijah Impey,) and also the surturbrand of Iceland, yielded some resin, which at Bovey is likewise found in distinct masses, intermixed with the strata of coal, and combined with asphaltum, in the proportion of about 41 parts of the latter with 55 of resin *.

Now, exclusively of the other vegetable characters which are so evident in many of the varieties of Bovey coal, of the Sussex coal, of surturbrand, &c. &c. the presence of resin must be regarded as a strong fact; for this substance has always been attributed to the organized bodies, particularly to those of the vegetable kingdom, and I do not know of any instance, previous to my own experiments, in which resin had been discovered as constituting part of any of the different species and varieties of coal.

From the external vegetable characters possessed by the Bovey coal, the Sussex coal, the surturbrand, and many others, together with the resin, (allowed to be exclusively a vegetable substance; or at least one which only appertains to the organized natural bodies,) there cannot be any doubt, that such coals have been formed from wood and other substances belonging to the vegetable kingdom.

But some mineralogists attempt to draw a line of separation between the coals above mentioned and the others, which therefore they call the true mineral coals.

* Observations on the Change of some of the proximate Principles of Vegetables into Bitumen. Phil. Trans. 1804, p. 405.

This

This opinion may in some degree be refuted even from the specimens afforded by the Bovey coal-pits, where, as I have observed, a regular gradation may be seen from wood which is but very imperfectly carbonized, to the substance called stone coal, which in every respect appears to be most nearly if not absolutely similar to the common pit-coals *.

It may however be objected, that such a transition is peculiar to this and similar places, and that the pit-coal found in other situations, where nothing resembling the Bovey coal can be discovered, is in reality of a different nature.

But this objection I think may be anwered by the results of those experiments on pit-coal, Cannel coal, and asphaltum, which I have related in the third section of this Paper; for when these were subjected to the action of nitric acid not too long continued, it was found, that the acid first dissolved the principal part of the carbonaceous matter, and if then the process was stopped, there remained a substance in a proportion corresponding to that of the bitumen either in the pit-coal, or principally forming the Cannel coal and asphaltum, which although not absolutely in the state of resin, was however in a state intermediate between it and the vegetable extractive matter.

Moreover I have stated, that under similar circumstances, a substance possessing in a great measure the same properties, may be obtained from the known vegetable resins by the action of nitric acid.

When, therefore, these facts are added to that of the natural mixture of resin and asphaltum which is found with the Bovey coal, we to all appearance have almost positive proof that the pit-coals are of vegetable origin.

* Phil. Trans. 1804, p. 398.

True

True it is indeed, that bitumen has never been formed by any artificial process hitherto devised, from the resins or other vegetable substances. I have myself attempted it in various ways without success, for although I occasionally obtained products which resembled it somewhat in odour when burned, and other properties, yet the effects of alcohol or water always proved these products not to be bitumen.

But synthesis of natural products, although required in strict chemical demonstration, is (as we have but too often occasion to know) seldom to be attained, especially when operations are performed on bodies whose component parts are liable to an infinite series of variations in their proportions, qualities, and mode of combination.

Considering therefore, that bitumen and resin afford by certain operations similar products, that resin and bitumen are found blended together by nature, and that this mixed substance accompanies a species of coal which in many parts still exhibits its vegetable origin, whilst in others it passes into pit-coal, we may with the greatest probability conclude, that bitumen is a modification of the resinous and oily parts of vegetables, produced by some process of nature, which has operated by slow and gradual means on immense masses, so that even if we were acquainted with the process, we should scarcely be able to imitate its effects, from the want of time, and deficiency in the bulk of materials.

But, although bitumen cannot at present be artificially formed from the resinous and other vegetable substances by any of the known chemical processes, yet there is every reason to believe, that the agent employed by nature in the formation of coal and bitumen has been either muriatic or sulphuric acid; and when it is considered, that common salt is never found in coal mines except when

when in the vicinity of salt springs, whilst on the contrary, pyrites, sulphate of iron, and alum, most commonly are present *; these facts, together with the sulphureous odour emitted by most of the mineral coals when burned, appear strongly to evince the agency of the latter. That this has been the case, seems also to be corroborated, by the great resemblance which (as has been previously stated) the coals formed artificially from many vegetable substances bear to the mineral coals, especially as the similarity is not confined to external characters, but extends to other properties.

By the action of sulphuric acid on vegetable bodies, a much greater portion of their carbon is converted into coal than when the same are subjected to the effects of fire.

Several examples respecting the resins, have been mentioned in the seventh section of this paper, and the result of the experiment made upon oak perfectly accords with them.

M. Proust, in the course of some comparative experiments on the proportions of charcoal afforded by different kinds of wood, obtained 20 *per cent.* from green oak, and 19 *per cent.* from heart of oak †.

But by sulphuric acid, from 480 grains of oak, I obtained 210 grains, or about 45 *per cent.* of coal, which burned not like the charcoal obtained from the same wood, but like many of the mineral coals; and this was also observed in the combustion of the greater part of the coals obtained by the humid way from resinous substances.

The experiment on oak also appears to refute another objection to the vegetable origin of pit-coal, namely,

* Kirwan's Geological Essays, p. 324.

† Journal de Physique, 1799, tome 48, p. 469.

the

the total absence of the alkalis, which on the contrary are so constantly obtained from the ligneous parts of vegetables by combustion *. But I have shewn, that when these bodies are carbonized in the humid way either by muriatic or by sulphuric acid, not any alkali can be obtained from the ashes of coals so formed; and this seems also to be a farther proof, that the humid way has been employed in the operations of nature to convert the above-mentioned substances into pit-coal; for supposing fire to have been the agent, it does not appear easy to conceive how the alkali could have been destroyed or separated †.

Every circumstance seems therefore to support the opinion of those who consider the pit-coals as having been formed in the humid way, principally from vegetable bodies, and most probably by the agency of sulphuric acid; and allowing that animal substances may also have contributed to the production of coal, yet this

* Kirwan's Geological Essays, p. 320.

† Some have attempted to account for the absence of alkali in the Bovey coal and common pit-coal, by supposing that the vegetable bodies (from which these have been formed) were previously deprived of alkali by simple lixiviation during their immersion in water. But in page 127 (p. 29.) of this Paper, I have shewn that the submerged oak of Sutton, although deprived of its tannin, still retained its potash, which certainly would not have been the case if the latter like the former could have been separated from the wood by mere solution. When wood is reduced to ashes, the alkali becomes completely denuded by the destruction of the woody fibre, and consequently may be immediately taken up by water; but, when wood is converted into coal in the humid way by means of an acid, then it seems to me that two effects take place; for the intimate combination of the alkali with the woody fibre becomes in a great measure destroyed by the carbonization of the latter, whilst a simultaneous action arises in the affinity between the acid and the alkali; so that if coal has been formed by such means, the alkali must have been separated from the wood in the state of a dissolved neutral salt.

would not militate against the above-mentioned opinion, as the effects produced upon them by that acid would in all the essential points be perfectly similar *.

* From the nature of the experiments which have been related in this Paper, I have unavoidably been induced to notice concisely the different opinions on the formation of coal by the humid way; but I did not intend to have mentioned any of those which have been brought forward in favour of the immediate or indirect action of fire, as I only wished to express my sentiments respecting the most probable of the former opinions.

Since, however, this Paper was written and partly read before the Royal Society, I have been favoured by Sir James Hall, with a copy of his Paper, intituled, "Account of a Series of Experiments shewing the Effects of Compression in modifying the Action of Heat;" and I am fully of opinion that the scientific world has not for a long time received any communication of more importance, or in which more accuracy, ability, and perseverance have been displayed †. The effects which Sir James Hall has produced on carbonate of lime by heat acting under compression, certainly removes a great and at one time apparently insurmountable obstacle to the Huttonian or Plutonian theory; and if they do not solve the grand geological problem, they must even, in an insulated point of view, be allowed to have opened a new and unexplored field of research in chemistry as well as in geology.

In the eighth section of this valuable Paper, the author has given an account of some experiments made on leather, horn, and fir saw-dust, from which he obtained coal which burned with flame, and which apparently resembled some of the mineral coals. In one case also, he obtained a substance, which in external characters appeared somewhat similar to the mixture of asphaltum and resin found at Bovey, to which I have given the name of Resin-asphaltum. These experiments Sir James Hall intends to resume, and it is my earnest wish that he would do so; for although I am strongly inclined to believe that the mineral coals have generally, if not always, been formed by some humid process, yet it is impossible to foresee the results which

† It may be agreeable to many of our readers to learn that a very concise but good abridgement of this valuable paper has been inserted in the sixth number of the Retrospect of Philosophical, &c. Discoveries; and that the whole of the extensive original has been introduced by Mr. Nicholson in the late numbers of his journal.

An

An inquiry into the nature and formation of coal was my first object when I discovered the artificial tanning substance; and considering the importance of the latter, it will not appear surprising, that it should immediately have engaged the principal part of my attention.

In addition to the experiments which have been related in the three Papers upon this subject, I intended to have decomposed the different varieties, to have compared their gases and other products with those of the natural substance called Tannin, and especially to have endeavoured to discover more economical methods of obtaining the artificial product; for, exclusive of speculative science, this appears to be an object of consequence, not only respecting that useful and valuable branch of manufacture to which it immediately relates, but also as the means of preventing, or at least of diminishing, the premature destruction of timber in a country, where, on account of its population, as well as on account of its maritime position, every economy in such an article should be most rigidly observed.

But for the present, I intend to relinquish this subject to such as may consider it worthy of attention; whilst, as I have already stated, I entertain very sanguine expectations, that eventually it will prove economically useful; and should any be inclined to pursue the inquiry, I would recommend particular attention to those processes which relate to the roasted vegetable substances, and to peat.

Almost any refuse vegetable matter, such as twigs, dead leaves, &c. will serve for the former; whilst the latter, as I have shewn, does not require to be roasted,

which may be obtained from animal and vegetable bodies subjected to the effects of heat modified by compression, as the principles of these bodies may be acted upon, and may be made to re-act on each other, under circumstances which until now have not been imagined.

and in many, especially the Northern counties, peat is found in such abundance, that but a small proportional quantity is consumed in the only useful way to which it has hitherto been applied, namely, fuel.

Before I conclude this Paper I shall also observe, that the experiments which have been described, must be regarded only as a mere sketch of that which may be performed, whilst the facts which have been ascertained respecting the resins, balsams, gum resins, and gums, serve to prove, that much may be expected from regular chemical examinations of these bodies. But such investigations, in order that science may truly be promoted, should be strictly regular; that is, they should not be taken up in a desultory manner, but these substances should be comparatively and systematically examined with all the accuracy which can be employed in the present state of chemical knowledge; for as this knowledge concerning the composition of organized bodies is confessedly very imperfect, I am persuaded, that like other of the sciences, chemistry will be less liable to error, when guided by comparative experiments and comparative analyses.

Processes for preparing cheap and durable Paints with Fish Oil. By Mr. THOMAS VANHERMAN, *of Mary-le-Bone-street, Golden-square.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal and Twenty Guineas were voted by the Society for this Communication.

HAVING applied a great portion of my time, for several years past, to discover a method of preparing a cheap and durable composition for the defence and preservation

servation of all works exposed to the inclemency of the weather, I have now the satisfaction of laying before the Society for the Encouragement of Arts, &c. specimens of some of the above colours ready prepared for use, which will, I flatter myself, be found superior to all others for cheapness and durability, equal to any in beauty, and not subject to blister or peel off by the sun.

The vehicle made use of for the said paints is fish-oil, the preparation of which is so simple, that when known, gentlemen who have large concerns to paint, may have this composition of any colour manufactured, and laid on by their labourers. I have sent a bottle of the prepared oil; also a number of patterns of various colours. The highest price of any does not exceed 3*d.* *per* pound, and many of them so low as 2*d.* in a state fit for use. I have likewise sent a pot of white-lead which has been ground with prepared fish-oil; and which, when thinned with linseed-oil, surpasses any white hitherto made use for resisting all weathers, and retaining its whiteness.

To refine one Ton of Cod, Whale, or Seal Oil, for Painting, with the Cost attending it.

	£.	s.	d.
One ton of fish-oil, or 252 gallons - - - - -	36	0	0
32 gallons of vinegar, at 2*s.* *per* gallon - -	3	4	0
12lbs. litharge, at 5*d.* *per* lb. - - - - - - -	0	5	0
12lbs. white copperas, at 6*d.* ditto - - -	0	6	0
12 gallons of linseed-oil, at 4*s.* 6*d.* *per* gallon	2	14	0
2 gallons of spirit of turpentine, at 8*s.* ditto	0	16	0
	£. 43	5	0

252 gallons of fish-oil,
12 ditto linseed-oil,
2 ditto spirits of turpentine,
32 ditto vinegar,

298 gallons, worth 4*s.* 6*d.* *per* gallon.

Which

		£.	s.	d.
Which produces	- -	67	1	0
Deduct the expense	-	43	5	0
		£. 23	16	0 profit.

To prepare the Vinegar for the Oil.

Into a cask which will contain about forty gallons, put thirty-two gallons of good common vinegar; add to this twelve pounds of litharge and twelve pounds of white copperas in powder; bung up the vessel, and shake and roll it well twice a day for a week, when it will be fit to put into a ton of whale, cod, or seal oil; (but the Southern whale oil is to be preferred, on account of its good colour, and little or no smell); shake and mix all together, when it may settle until the next day; then pour off the clear, which will be about seven-eighths of the whole. To this clear part add twelve gallons of linseed-oil and two gallons of spirits of turpentine; shake them well together, and after the whole has settled two or three days it will be fit to grind white-lead and all fine colours in; and when ground, cannot be distinguished from those ground in linseed-oil, unless by the superiority of its colour.

If the oil is wanted only for coarse purposes, the linseed-oil and oil of turpentine may be added at the same time that the prepared vinegar is put in; and, after being well shaken up, is fit for immediate use without being suffered to settle.

The vinegar is to dissolve the litharge, and the copperas accelerates the dissolution, and strengthens the drying quality.

The residue, or bottom, when settled, by the addition of half its quantity of fresh lime-water, forms an excellent

lent oil for mixing with all the coarse paints for preserving outside work.

Note. All colours ground in the above oil, and used for inside work, must be thinned with linseed-oil and oil of turpentine.

*** The oil mixed with lime-water I call *incorporated oil.*

The Method of Preparing, and the Expense of the various Impenetrable Paints.

First. — *Subdued Green.*

	£.	s.	d.
Fresh lime-water, 6 gallons - - - -	0	0	3
Road-dirt finely sifted, 12 pounds - -	0	1	0
Whiting, 112 ditto - - - - - - - -	0	2	4
Blue-black, 30 ditto - - - - - - - -	0	2	6
Wet blue, 20 ditto - - - - - - - -	0	10	0
Residue of the oil, 3 gallons - - - -	0	6	0
Yellow ochre in powder, 24 pounds - -	0	2	0
	£. 1	4	1

This composition will weigh 368 pounds, which is scarce one penny *per* pound. To render the above paint fit for use, to every eight pounds add one quart of the incorporated oil and one quart of linseed oil, and it will be found a paint with every requisite quality, both of beauty, durability, and cheapness, and this state of preparation does not exceed 2½*d. per* pound; whereas the coal tar of the same colour is 6*d.*

The Method of mixing the Ingredients for the Subdued Green.

First, pour six gallons of lime-water into a large tub, then throw in 112 pounds of whiting; stir it round well with

with a stirrer, let it settle for about an hour, and stir it again. Now you may put in the 112 pounds of road-dirt; mix it well, then add the blue-black, after which the yellow-ochre, and when all is tolerably blended, take it out of the tub, and put it on a large board or platform, and with a labourer's shovel mix and work it about as they do mortar. Now add the wet blue, which must be previously ground in the incorporated oil (as it will not grind or mix with any other oil). When this is added to the mass, you may begin to thin it with the incorporated oil in the proportion of one quart to every eight pounds, and then the linseed oil in the same proportion, and it is ready to put into casks for use.

Lead Colour.

	£.	s.	d.
Whiting, 112 pounds - - - - -	0	2	4
Blue-black, 5 ditto - - - - - -	0	1	8
Lead ground in oil, 28 ditto - - -	0	14	0
Road-dirt, 56 ditto - - - - - -	0	0	6
Lime-water, 5 gallons - - - - -	0	0	6
Residue of the oil, 2½ ditto - - -	0	5	0
Weighs 256 pounds.	£. 1	4	0

To the above add two gallons of the incorporated oil, and two gallons of linseed-oil to thin it for use, and it will not exceed 1¼*d. per* pound.

Note. The lime-water, whiting, road-dirt, and blue-black, must be first mixed together, then add the ground lead, first blending it with two gallons and a half of the prepared fish-oil; after which thin the whole with the two gallons of linseed-oil and two gallons of incorporated oil, and it will be fit for use. For garden-doors, and other work liable to be in constant use, a little spirits of

turpentine

turpentine may be added to the paint whilst laying on, which will have the desired effect.

Bright Green.

	£.	s.	d.
112 lbs. yellow ochre in powder, at 2*d*. *per* lb.	0	18	8
168 ditto road-dust - - - - - - - - - - - -	0	1	8
112 ditto wet blue, at 6*d*. *per* lb. - - - - -	2	16	0
10 ditto blue-black, at 3*d*. ditto - - - - -	0	2	6
6 gallons of lime water - - - - - - - -	0	0	6
4 ditto fish-oil prepared - - - - - - -	0	12	0
$7\frac{1}{2}$ ditto incorporated oil - - - - - - -	0	15	0
$7\frac{1}{2}$ ditto linseed-oil, at 4*s*. 6*d*. *per* gallon -	2	8	9
592 lbs. weight.	£. 7	15	1

This excellent bright green does not exceed three pence farthing *per* pound ready to lay on, and the inventor challenges any colour-man or painter, to produce a green equal to it for eighteen pence.

After painting, the colour left in the pot may be covered with water to prevent it from skinning, and the brushes, as usual, should be cleaned with the painting knife, and kept under water.

A brighter green may be formed by omitting the blue-black; and

A lighter green may be made by the addition of ten pounds of ground white-lead.

A variety of greens may be obtained, by varying the proportions of the blue and yellow.

Observe that the wet blue must be ground with the incorporated oil, preparatory to its being mixed with the mass.

Stone Colour.

	£.	s.	d.
Lime-water, 4 gallons - - - - - - - - - -	0	0	4
Whiting, 112 pounds - - - - - - - - -	0	2	4
White-lead ground, 28 pounds, at 6*d.* *per* lb.	0	14	0
Road-dust, 56 pounds - - - - - - - - - -	0	0	6
Prepared fish-oil, 2 gallons - - - - - - -	0	6	0
Incorporated oil, 3½ gallons - - - - - -	0	7	0
Linseed-oil, 3½ ditto - - - - - - - - -	0	15	9
Weighs 293 pounds.	£. 2	5	11

The above stone colour, fit for use, is not two pence *per* pound.

Brown Red.

	£.	s.	d.
Lime-water, 8 gallons - - - - - - - - - -	0	0	8
Spanish brown, 112 lbs. - - - - - - - -	1	0	0
Road-dust, 224lbs. - - - - - - - - - -	0	2	0
4 gallons of fish-oil - - - - - - - - - -	0	12	0
4 ditto incorporated oil - - - - - - - -	0	8	0
4 ditto linseed-oil - - - - - - - - - -	0	18	0
Weighs 501 pounds.	£. 2	0	8*

This most excellent paint is scarcely one penny *per* pound.

The Spanish brown must be in powder.

A good chocolate colour is made by the addition of blue-black in powder or lamp-black, till the colour is to your mind; and a lighter brown may be formed by adding ground white-lead.

Note. By ground lead is meant white-lead ground in oil.

* The sum cast up is erroneous.

Yellow

Yellow is prepared with yellow ochre in powder, in the same proportion as the Spanish brown.

Black is also prepared in the same proportion, using lamp-black or blue-black.

To whiten Linseed-Oil.

Take any quantity of linseed-oil, and to every gallon add two ounces of litharge; shake it up every day for fourteen days, then let it settle a day or two; pour off the clear into shallow pans, the same as dripping-pans, first putting half a pint of spirits of turpentine to each gallon. Place it in the sun, and in three days it will be as white as nut-oil.

This oil, before it is bleached, and without the turpentine, is far superior to the best boiled oil, there being no waste or offensive smell.

From experiments made, it appears that fine sand will not answer the purposes of road-dirt in painting, and that this dry dirt or dust collected in highways much travelled by horses and carriages, and afterwards finely sifted, is the article recommended, as possessing the properties required.

I beg leave here to subjoin a receipt for a constant white for the inside painting of houses; which paint, though not divested of smell in the operation, will become dry in four hours, and all smell gone in that time.

White Paint.

To one gallon of spirits of turpentine, add two pounds of frankincense, let it simmer over a clear fire until dissolved; strain it, and bottle it for use. To one gallon of my bleached linseed-oil, add one quart of the above,

shake them well together, and bottle it also. Let any quantity of white-lead be ground with spirits of turpentine very fine, then add a sufficient portion of the last mixture to it, until you find it fit for laying on. If in working it grows thick, it must be thinned with spirits of turpentine.—It is a flat or dead white.

The following letter was received by Mr. Vanherman from Mr. Hill, of West Lavant, Sussex, Builder and Surveyor, to the Duke of Richmond.

Sir,

I have just received your letter, dated the 5th instant, and am happy to find that your oil and colour business so well stands the test of others, as well as that of myself. The fish-oil composition you made use of, in all the painting you have done at Earl's Court, Kensington, for his Grace the Duke of Richmond, under my superintendance, in 1802-3, was fully equal, if not superior, to any painting done in the usual way with linseed-oil, white-lead, &c. I have also the highest opinion of your coarse composition and fish-oil you made use of on the out-buildings, fences, &c. on the above premises; the great body, and hard surface it holds out, must be of the greatest preservation to all timbers and fences exposed to open air and all weathers. It must also be of the greatest service on plastered stucco, external walls, &c.

If any farther attestation from me, relative to the business you did at the above premises, can be of any service to you, you will command,

Sir, your obedient servant,

W. HILL.

Method

Method of cleansing Silk, Woollen, and Cotton Goods, without Damage to the Texture or Colour.

By Mrs. ANNE MORRIS, *of Union-street, near the Middlesex Hospital.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Fifteen Guineas were voted by the Society to Mrs. MORRIS *for this Invention.*

TAKE raw potatoes, in the state they are taken out of the earth, wash them well, then rub them on a grater over a vessel of clean water to a fine pulp, pass the liquid matter through a coarse sieve into another tub of clear water; let the mixture stand till the fine white particles of the potatoes are precipitated, then pour the mucilaginous liquor from the fecula, and preserve this liquor for use. The article to be cleaned should then be laid upon a linen cloth on a table, and having provided a clean sponge, dip the sponge in the potatoe-liquor, and apply the sponge thus wet upon the article to be cleaned, and rub it well upon it with repeated portions of the potatoe-liquor, till the dirt is perfectly separated; then wash the article in clean water several times, to remove the loose dirt; it may afterwards be smoothed or dried.

Two middle-sized potatoes will be sufficient for a pint of water.

The white fecula which separates in making the mucilaginous liquor, will answer the purpose of tapioca, will make an useful nourishing food with soup or milk, or serve to make starch or hair-powder.

The coarse pulp which does not pass the sieve is of great use in cleaning worsted curtains, tapestry, carpets, or other coarse goods.

The

The mucilaginous liquor of the potatoes will clean all sorts of silk, cotton, or woollen goods, without hurting the texture of the article, or spoiling the colour.

It is also useful in cleansing oil-paintings, or furniture that is soiled.

Dirty painted wainscots may be cleaned by wetting a sponge in the liquor, then dipping it in a little fine clean sand, and afterwards rubbing the wainscot therewith.

Various experiments were made by Mrs. Morris, in the presence of a Committee, at the Society's house: the whole process was performed before them upon fine and coarse goods of different fabricks, and to their satisfaction.

Experiments made at the Request of the Board of Agriculture. By Mr. John Wright.

From the Communications to the Board of Agriculture.

Experiment I.

Conclusion of the Experiment on the comparative Value of Manures — Fourth Year Oats, after Clover on one Ploughing.

Feb. 26, 1805, ploughed the clover ley for oats; March 7, sowed and harrowed the four half roods with two pecks and a half each.

August 14, mowed and gathered into sheaves, and on the 24th threshed, on a large cloth in the field.

Produce.

			Per Acre.		Value at 24s.		
	Bush.	Pecks.	Bush.	Pecks.	£.	s.	d.
No. 1. Fresh stable dung	4	3	38	0	5	14	0
No. 2. Rotten ditto	5	0	40	0	6	0	0
No. 3. Burnt straw	4	3	38	0	5	14	0
No. 4. Without	4	0	32	0	4	16	0

The

The half rood without manure, producing after the rate of four quarters *per* acre, rather surprised me, and shews the fertility of the manures to be greatly abated; which, however, on this light soil, is no more than what might be expected.

Recapitulation. — *Value of the Crops for Four Years.*

	£.	s.	d.
No. 1. Fresh stable dung, 1st year turnips, *per* acre - - - - - - - - - - - - -	3	0	0
2d ditto barley, at 36*s*. *per* quarter	6	17	3
3d ditto clover - - - - - - - -	1	10	0
4th ditto oats, at 24*s*. - - - - -	5	14	0
	£. 17	1	3
No. 2. Rotten dung, 1st year turnips, *per* acre	2	15	0
2d ditto barley - - - -	8	5	4½
3d ditto clover - - -	1	11	6
4th ditto oats - - - -	6	0	0
	£. 18	11	10½
No. 3. Burnt straw, 1st year turnips, *per* acre	1	15	0
2d ditto barley - - -	6	16	1½
3d ditto clover - - -	1	7	0
4th ditto oats - - -	5	14	0
	£. 15	12	1½
No. 4. No manure, 1st year turnips, *per* acre	0	4	0
2d ditto barley - - -	3	6	4½
3d ditto clover - - -	0	12	0
4th ditto oats - - - -	4	16	0
	£. 8	18	4½

Gross

	£.	s.	d.
Gross produce of one acre for four years, manured with twenty-four tons of fresh stable dung, in a straw state - - - - - -	17	1	3
Ditto of one acre unmanured, on the same soil	8	18	$4\frac{1}{2}$
Value of the stable manure to the occupier £.	8	2	$10\frac{1}{2}$
Gross produce of one acre for four years, manured with sixteen tons of rotten stable dung, made from the said materials, 8 months old	18	11	$10\frac{1}{2}$
Ditto, unmanured, on the same soil - - -	8	18	$4\frac{1}{2}$
Value of the rotten dung to the occupier £.	9	13	6
Gross produce of one acre for four years, manured with six tons of dry barley straw, burnt on the ground, ploughed shallow immediately and sowed - - - - - - - - -	15	12	$1\frac{1}{2}$
Ditto one acre unmanured, in the same soil	8	18	$4\frac{1}{2}$
Value of the burnt straw to the occupier £.	6	13	9

This experiment shews the value of manures to the farmer in a very inviting point of view indeed, and how much it behoves him to strain every nerve to obtain a copious dressing for his ground, if he would farm to profit, which is what we all aim at. In the comparison of manures, rotten dung appears superior, but that depends upon whether twenty-four tons of stable dung would make sixteen of rotten or spit dung eight months old. I am of opinion it would not, at least such as I used, and perhaps not more than twelve tons: now, if only twelve tons had been employed in the present case, instead of 9*l.* 13. 6*d.* in

in all probability there would have been but 7*l.* 4*s.* 1¼*d.* which is almost one pound less than the stable manure produced; therefore we cannot be certain which of these is best, until we know at a certainty how much a ton of stable manure will weigh when rotten: however, there is one thing we may be satisfied about, that they are both exceedingly valuable to the farmer, as well as the burnt straw.

Experiment II.

An Experiment to prove whether Spring Wheat, Barley, Oats, or Autumnal Wheat, will pay the Farmer best after Turnips; the Turnips fed off by Sheep.

April 8, 1805. Four half roods were measured off and sowed, in the following manner, all on the same day.

	Peck.	Quart.	
No. 1. Sowed with	1	1	of spring wheat, broadcast.
No. 2. Ditto - -	2	0	of barley, ditto.
No. 3. Ditto - -	2	4	of oats, ditto.
No. 4. Diito - -	1	2	of common autumnal wheat, d°.

I do not know whether the above quantities of seed will be considered the most proper: I can only add, they are the most general quantities used here. They all proved very fine crops, but the rapidity of the growth of the spring wheat was truly astonishing.

Produce.

							Per Quarter.			
	Bu.	Pk.	Qt.	*l.*	*s.*	*d.*	*l.*	*s.*	*d.*	Reaped.
No. 1. Spring wheat -	3	1	1 at	3	0	0 -	1	4	7¼	Aug. 31.
No. 2. Barley - - -	5	0	1 -	1	16	0 -	1	2	7½	—— 31.
No. 3. Oats - - -	7	0	2 -	1	4	0 -	1	1	2¼	—— 24.
No. 4. Autumnal wheat	2	0	1 -	3	0	0 -	0	15	2¼	Sept. 20.

The autumnal wheat, although a very fine crop, was, from being so late sowed, overtook by the mildew; which, I fear, must often be the case, especially as this

was not a mildew year; as it was perfectly green when all the others were down ripe. It appeared, indeed, as if Nature had not time to perform her offices, as many large ears were nearly empty, being nothing more than shapes of ears. The superiority of the spring wheat over the autumnal, is very great indeed, being 3*l.* 15*s.* 4*d.* *per* acre, exclusive of the difference in quality, and the price each would have fetched at market; as the spring wheat was worth at least 10*s.* *per* quarter more than the other, on account of its being mildewed, and very thin and light, which makes more than 4*l.* 15*s.* 4*d.* *per* acre superiority, which is the value of an ordinary crop. I have charged them all at the prices I judged necessary they should be at to pay the grower, and not what they would actually bave sold for at the time; wheat at 3*l.* barley at 1*l.* 16*s.* oats at 1*l.* 4*s.* Should you think these prices improper, they may be easily altered.

Experiment III.

An Experiment made in order to ascertain the proper Depth Seed Barley should be deposited in the Earth, after Turnips, to produce the greatest Crop.

April 9th, 1805. Four half roods were measured off, ploughed, and sowed as follows:

No. 1. Sowed with two pecks of barley, the ground tilled and harrowed fine, and then the seed sown, and no more harrowing than merely to hide the seed from the birds.

No. 2. Sowed with ditto, previous to harrowing, consequently buried deeper than No. 1.

No. 3. Sowed with ditto, and ploughed in two inches deep.

No. 4. Sowed with ditto, and ploughed in four inches deep.

The crops of all excellent, and no superiority discernible by the eye: all reaped September 2.

Produce.

Produce.

	Bush.	Pk.	Qt.		£.	s.	d.
No. 1.	6	0	2	value *per* acre, at 36*s.* *per* qr.	10	18	3
No. 2.	5	2	1	—— —— ——	9	19	1½
No. 3.	5	0	5	—— —— ——	9	5	7½
No. 4.	5	0	4	—— —— ——	9	4	6

This experiment appears quite conclusive in favour of shallow sowing, as the quantity decreases every time as the seed is laid deeper. I shall beg leave to assign two reasons for it, though perhaps neither of them the real cause. First, by harrowing No. 1 previous to sowing, the surface was laid even, and the seed fell much more regular over it; whereas, when seed is sowed upon rough land, it is not uncommon to see ten corns lie in a square inch, and a square foot near it without one, owing to the seed rebounding, and falling into the lowest parts; it likewise gets buried at different depths, and consequently is not all up together. Secondly, by ploughing, it is unequally distributed, and some of it totally buried, especially that four inches deep. After all, this, like a great deal of other agricultural practice, must be left to the agriculturist; for upon a dry burning soil, highly manured, and a hot, dry summer, the ploughed in might answer the best; but upon a cool loamy soil I should prefer the harrowing.

Experiment IV.

An Experiment made to ascertain the Effects of Manures for Barley, or naked Fallow.

April 11th, 1805. Nine half roods were measured off, manured, and sowed as follows, with two pecks of barley each:

No. 1. Manured with one cart load of long fresh stable dung.

No. 2. Two ditto.

No. 3. Three ditto.

No. 4. One-fourth of a load of the same dung, rotten spit dung.

No. 5. One-half of a load ditto.

No. 6. Three-fourths of a load ditto.

No. 7. Three-quarters of a ton of barley-straw, spread over and burnt immediately, before sowing the seed, and well harrowed in.

No. 8. Three-quarters of a ton of bean-straw, burnt the same.

No. 9. No manure: all mowed Sept. 9th.

Produce.

	Bu.	Pk.	Qt.				£.	s.	d.
No. 1.	3	0	5	value *per* acre	at 36*s.*	*per* qr.	5	13	7½
No. 2.	3	1	2	——	——	——	5	19	3
No. 3.	3	2	0	——	——	——	6	6	0
No. 4.	3	0	4	——	——	——	5	12	6
No. 5.	3	1	1	——	——	——	5	18	1½
No. 6.	3	1	6	——	——	——	6	3	9
No. 7.	4	0	0	——	——	——	7	4	0
No. 8.	3	1	7*	——	——	——	6	4	10¾
No. 9.	2	1	4	——	——	——	4	5	6

* I have one remark to make on the bean-straw producing less than the barley-straw. Just as we had finished burning the barley-straw, and going to burn the bean, a heavy shower of rain fell, and though we waited as long as we conveniently could, to get it sowed that day, and kept turning it, yet it did not burn down well and kindly; to which I attribute the deficiency. It appears; however, very clear to me, that burnt straw, for the first crop, is a very excellent manure; as soon as it came up it looked best, and all through the summer the difference in colour was discernible, as far as the land could be seen. Here is 3*l.* within 18*d.* for the barley-straw burnt on the first crop; the whole was thrashed on a large cloth in the field, which I find the most accurate method: the greatest disadvantage is, it employs the hands when wanted for harvest.

On

On the Inefficacy of bending Axles forward as a Remedy for the destructive Effects of Conical Carriage-Wheels; together with Observations on a practical or second Sort of Conical Friction, &c. By an Engineer.

Communicated to the Editors by the Author.

Gentlemen,

So many ruinous effects have been proved to result from the use of wide-rimmed conical carriage-wheels, and the same been so ably and clearly explained by Alexander Cummings, Esq. in a communication to the Board of Agriculture, and which you have inserted in the 13th volume of The Repertory of Arts, &c. that it seems to me impossible the use of such wheels should have been continued to the present time, but from that absurd hypothesis of bending the axles forward, as a means of counteracting those grinding effects which such wheels invariably produce. The purpose of this comunication is therefore to shew the inefficacy of this pretended alleviation. But first I beg to observe, that in practice there seems to exist a new or second description of conical friction, which I hope to explain, and which evidently affects narrow-rimmed conical wheels more than wide ones, while in its effect it may be said neither to increase nor decrease the operation of the principal or first description of conical friction described by Mr. Cummings. If I should be fortunate enough to explain the effect of this second description half so clearly as that gentleman has the first, the simple additions of one to the other will shew the whole complicated conical friction that under various circumstances exists; and though I shall only endeavour to explain this effect with imaginary narrow-rimmed conical wheels, it will be easy to conceive the effect on wide rims, by supposing such to be composed of so many narrow rims put together, each of which being allowed

to

to support only its portion of a given weight, it will clearly appear that the narrow-rimmed wheel supporting the whole of a like given weight will create as much of this friction as the wide-rimmed wheel when sunk but an equal depth in the road; and that inasmuch as the narrow wheel sinks deeper than the wide one it will create a greater degree of the said friction.

Now as the best turnpike roads act more or less elastic, by constantly fitting their surface more or less to the convexity of the various sized carriage-wheels passing over them, it will be necessary to imagine a road uncommonly elastic, to point out more clearly the effect of the common elasticity of roads in general; and as what are commonly called bad roads permit all wheels with narrow rims to enter more or less into their surface, it will be allowable to imagine a situation where such wheels would cut very deep, to point out as clearly the effect of their cutting shallow depths; inasmuch as it is usual to magnify a mite to judge of its particulars.

Presuming, therefore, that I am allowed all this extent of imagination, and having provided an imaginary cart, the axles of which are susceptible of being bent more or less forward or more or less downward at pleasure, and are likewise fitted to various wheels; I shall proceed to make my first imaginary experiment, by ordering the cart with its axles straight, and supported by cylindrical wheels, to be drawn on the surface of the elastic road; but, before I proceed farther, let it be understood that as the imagination may divide the circumference of wheels into any number of segments, I shall uniformly consider that three segments of the rim of each wheel bear on the ground at the same time, and these I shall distinguish thus:—that over which the axle of the wheel is perpendicular, I shall call the bottom segment, and the other two descending and ascending segments. The cart being

sufficiently

sufficiently loaded, I shall suppose sufficient concaves to be now formed to permit the bottom segment of each wheel to sink six inches below the common surface; and under such circumstances, the load will be found to cause just so much resistance as the force required, in addition to the elasticity of the hind parts of the concaves to make the fore parts give way; but, if we take off the vertical wheels, and after bending down the axle about 10 degrees put on conical wheels, we shall experience an additional resistance of much importance, notwithstanding the under-segment of each wheel is no more below the common level of the road now than when the vertical wheels were on; nor can the principal sort of conical friction occasion this additional resistance, because the rims of these wheels are very narrow; however, it is worthy some attention to examine the cause; in doing which, let it be considered that, if the bottom segments are but five feet apart, the descending segments are five feet two inches, and the ascending ones the same; so that it is evident that as the centres and upper rims of the wheels advance, to cause the descending segments to become bottom ones, such will necessarily be drawn two inches nearer together, while the bottom ones in becoming ascending segments, are driven two inches farther apart; and as neither of them have been removed from the ground, they must have rubbed with considerable friction. This, then, we may with much propriety call practical conical friction; and one would think that if the bending of axles forward alleviated any conical friction, it must be this; for surely no man who thinks reasonably, can suppose the bending axles either forward or backward can cause one part of the rim of a conical wheel to make a greater number of revolutions in going a given distance than another; and Mr. Cummings has

has plainly shewn that the principal sort of conical friction cannot be otherwise got rid of; for put a conical body in what position you will, the small end must travel over so much ground as the large end, in proceeding in strait forward directions, and unless it be allowed to make a greater number of revolutions, it must necessarily rub over a proportion of surface forward, while the large end rubs over nearly an equal portion backward, for the mutual accommodation of each other; but if it really be expected by wheelwrights, that bending the axle forward gives the outer edge of a wide-rimmed conical wheel an advantage, to enable that edge to trundle as freely over as much ground as the inner or larger diameter edge, I cannot better convince them of their error than by saying, their expectations can be no better founded than those of a volunteer officer, who finding some short-legged men at the left of his company are not enabled to keep step with the long-legged men on their right, orders the left to advance, and proceeds to march his company in a diagonal line, to give the short-legged men the advantage.

However, as I am not willing to believe that this general practice of bending axles forward can be so truly ridiculous in every point of view, let us now give the wheelwright's scheme a fair trial relating to practical friction, by bending the axles of the cart forward, till we perceive the descending segments brought as near together as the bottom ones; and if we now examine the effect, we shall find that the descending segments are really exempt from this kind of conical friction thereby, and so far the wheeler is right; but, unfortunately for his plan, it appears that the bottom segments in ascending are now driven off two inches each instead of one, so that we are no better off with the wheelwright's assistance than with-

out

out it. Perhaps, here prejudice may say the wheelwright's scheme has some advantage, inasmuch as the fore parts of the concaves are more liable to friction than the hind parts, in consequence of the power of the horses acting against them; this I admit, but not without first observing, that on tolerable level roads the force of such acting power is not quite a hundredth part as much as the weight of the whole load; and as a set off against this hundredth part or a few more such, I simply ask any reasonable man, if it is not probable that less friction will take place, by rubbing any body one inch forward and one inch back, than two inches forward on a common turnpike road, since it is presumed the soil will give way a small degree in alleviation of each inch of friction in the former; whereas in the latter it may be said to alleviate only part of one inch, &c. However, without altering either the axles or wheels, we will proceed with the cart to a neighbouring pasture-field, and see the effect of the bent-forward axle there. To our great mortification, we find that a moderate team of horses, together with the velocity the cart acquires previous to its entering the field, will not enable us to get but a few yards on the pasture, when we have cause to sing out in the carter's language, "we're all stuck fast;" for here we shall discover that the descending segments of the wheels have been cutting two deep ruts, while the ascending ones have been ploughing two equally deep furrows. If the axles had not been bent forward, no furrows would have been ploughed, because, though these wheels are conical, and run on bent-down axles, they would have received no more impediment from the sides of their own cut ruts, than vertical wheels would receive from their own; since it is obvious that vertical wheels will cut vertical ruts, whose sides will be parallel to the sides of such wheels,

 while

while it is equally obvious that conical or inclining wheels will cut ruts equally inclining, and of course equally parallel to the sides of their rims; so that inasmuch as the bending of axles forward is useless in good roads, we see it injurious in bad ones. From the preceding reasoning therefore, it must be highly necessary to adopt some better means to prevent the enormous extra wear and tear of roads, wheels, and horses, occasioned by the ground friction of conical carriage-wheels with either wide or narrow rims. I am strongly of opinion, that nothing but cylindrical and strait axles, generally adopted, can obtain this desirable purpose. Those who want a great width of room on their carriages, to be used for such purposes as stage-waggons, &c. might lengthen their axle-cases; and as stage-coaches would also require their axle-cases to be lengthened, the extra-width gained thereby between the under segments of the wheels would greatly lessen the probability of those coaches being upset, which we know often happens. Moreover, those noblemen and gentlemen who may think the benefit of conical wheels to their carriages to throw off the dirt of greater consequence to them than the benefit of cylindrical wheels to save their horses, &c. would of course have no objection to pay the public handsomely for the extra-injury they did the common roads (I mean in the shape of an extra tax or toll).

I have reason to believe that Parliament will ere long enforce the use of cylindrical wheels, I propose therefore next month, if agreable to the Editors of the Repertory, to offer my opinion at considerable length on the comparative advantage of wide and narrow rims, and of the great and small diameters of such wheels, together with the comparative resistance occasioned by each sort sinking more or less deep into the ground; also on central frictions

tions of carriage-wheels, including observations on wood and iron axles; and likewise on the most proper line of draft under various circumstances for the horse, &c.

I beg it may be understood that what I have herein said, does not relate to the ascending of hills; but that I consider it equally applicable, provided all extra-impediment then experienced be attributed to the actual gravity of the whole body to be moved on an inclined plane; that is to say: there will be as much extra-resistance experienced by a well-constructed carriage as any other of equal weight ascending the same hill.

I am, Gentlemen, yours, &c.

AN ENGINEER.

On the Culture of Carrots; with a Method of accelerating the Vegetation of Corn and Carrots. By M. ALPHONSE LEROY.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

I HAVE often reflected on the very great advantages that might be derived from the Chinese custom of causing their grain to germinate before they sow it. By this method they lengthen the year on one hand, and on the other they abridge the time requisite for the seed to remain in the earth, in order to re-produce itself. Thus in the North, where from the harvest to the sowing time the interval between them is very short, an advantage equal to extending the length of this interval is gained by sowing germinated grain. On the other hand, when the sowing time in France, for example, has been delayed by considerable rains, the grain may be sown very late in the year, provided it be previously made to germinate.

There are, besides, other advantages to be derived from this practice, which I shall mention hereafter, when speaking of carrots.

Perhaps it may be no less important to make known a principle in agriculture to which I am myself attached; that is, never to commit to the soil any seed that has not been produced from a country South of that in which you mean to sow it; and this principle has appeared so important to me, that I have made it the subject of a separate work.

From among a very great number of experiments which confirm the importance of these two practices, I shall choose two, one on the manner in which I have cultivated and prepared the grain, and the other on the preparation and culture of carrots in the large way.

Towards the middle of December 1793, when two months of the sowing season were already past, I had nearly an acre of land which had been prepared, but not sown. I imagined that it would be useless to sow it, because the cold state of the earth would not have permitted it to take effectual root; the grain might have swelled, but it would have putrified, because the moist and cold earth would have dissolved the constituent caloric (of the grain), which would have been produced in the germination. In effect, if the seed is lost and destroyed in great quantities, even when it has been committed to the earth in good time, if the earth happen to be too cold and moist, how much more certain must this loss be when the grain is sown in a season nearer winter. I resolved to practise the Chinese custom, which consists in not sowing the grain, until they have previously caused it to germinate; but I thought it proper to give it a coating of a compost hereafter described, in order to preserve the caloric which is necessary to its germination.

I was confirmed in this project, from being informed by the great agriculturists of the Canton, that, when the

corn

corn in the ground has once taken effectual root, it is free from all danger of succeeding frosts.

I further resolved to employ no grain but such as came from more than 30 leagues South of my situation. I had a small quantity of fine corn from Beauce, which I employed.

All the agriculturists of my Canton, which was in Picardy, blamed an attempt to sow so late in the season. They all told me that my seed would be lost; but I was persuaded of the contrary. It was in vain that I told them that in Courland, and in some provinces much farther North, the seed is sown when almost germinated; I could not persuade them to assent to this theory.

The following is my method of preparing the seed-grain: I soaked it for 48 hours in water; I afterwards drained the water from the sand, and made the following preparation to encrust it with.

I mixed together equal parts of the dung of sheep, horses, cows, and clayey earth, the rubbish of an old hovel. I diluted the whole with water, and boiled this thick mixture, in order to deprive it of its acrid and putrifying volatile principle, and at the same time to destroy the insects which it naturally contained: when lukewarm I poured it upon my seed-corn. I mixed the whole together, which made a coating on my seed, and I strewed a little slacked lime, stirring the grain about at the same time. I afterwards laid over it a large woollen covering, and at the end of three days it was considerably enlarged, and began to germinate.

I sowed this corn Dec. 22, 1793, and I used less seed by one fourth than the usual quantity, on account of the increased size of my corn and its coating. On the 28th, that is to say, six days afterwards, there was a sharp frost, but my grain was already visible above ground, and

and was not injured. We had afterwards snow, and though my seed had been sown nearly two months and a half later than any others, I gathered a very fine crop the beginning of August.

Desirous of varying my experiments on this practice, I applied it to the culture of carrots in the large way. I proposed also to make many experiments on this root, seeing the considerable advantages to be derived from it, as a means of nourishing and fattening cattle, and even as a food for man. Believing too that it may be rendered very useful in several other respects, I think the cultivation of this root may become one of the most lucrative branches of husbandry.

One of the greatest obstacles to the cultivation of this root to any great extent is, that it requires weedings, which are in the first place expensive, and in the second very difficult, because this labour requires a great number of hands, which are not always to be had. This is the inconvenience with which I set out.

The seed of carrots is nearly six weeks in shooting forth a few heads which hardly cover the earth, in which time the weeds become powerful, and if not removed they would choak up the young heads, and even the plant itself. It is not till about three months after the seed has been sown that the leaves begin to grow large, and in five months they are very vigorous, and rise more than three feet above the earth in good land. From a small portion of the ground I cut off the tops of the carrots, and this appeared to me to cause the root to increase in size, which I gathered in November.

I intended to have sown some winter barley with these carrots; and in that case I should have gathered the tops and the barley in June, and the carrots in November, which from having been nearly a year in the ground would

would have been larger, and more succulent; and this method would have produced me a double crop one after the other from the same soil.

I had taken care to have the land three times deeply ploughed. The last ploughing was done only some days before it was sown.

I must observe here, that my land was a little sandy. I prepared my grain as follows:

I infused it for six days in water; I afterwards made a compost similar to that for my corn; I moreover added to it a decoction of soot, in order to disperse the insects; I then wrapped the grain in linen steeped in luke-warm water, and I inclosed the whole in a very humid state in some manure which retained a mild heat internally. In about six days the swelled grain was ready to germinate. I put nearly ten times as much sandy earth as grain. I mixed the whole well, and sowed it in my land which had been harrowed, and I afterwards had it rolled. In about 10 or 12 days the carrots appeared; and they covered the ground so well that the weeds did not shew themselves.

Two months afterwards I had only to pluck up an overplus, that amply indemnified me for the trouble; and in about four months and a half I had a valuable crop of tops. In fact, I gathered from about an acre of land eleven large cart-loads of roots.

It is to be observed that this took place in Picardy, a Northern province of France, and this carrot appears to me to belong rather to cold than to warm countries. It appears to me to abound so much more in the sugary principle as the land where it is cultivated has less sun and is more sheltered by mountains and woods. It likewise appears to me to be of consequence that this mode of culture should be preferred in the Northern departments;

and

and I think it equally essential to advise those who are desirous of trying this method, to be careful not to procure their grain from a soil North of their own, but from a country that lies to the South of it, because it is a general rule that the product of seed improves in going from South to North, and that it decreases in virtue in going from North to South; and I am of opinion that the same land is capable of producing two plentiful crops, and that corn afterwards sown on it would thrive wonderfully.

I must observe that the land should not be newly manured, because manure injures carrots, especially when it is fresh, and subjects it to cankers, and to be worm-eaten.

Botanists distinguish two kinds of leguminous carrots; the one long, and the other round. That which succeeds best in Picardy is a long carrot, and the round one appears to me to succeed best towards the South of France. There is besides the white and the red. I should propose a mixture of both.

I have fed and fattened with this root only, many pigs, and the flesh of these animals was excellent, and preferable to that fed in the usual way. I fed them with these carrots, prepared as follows:

The best and most economical method of preparing food that is intended to feed and fatten animals, is by decoction and fermentation. I have ascertained this by numberless experiments.

This mode of nourishment which I have used for pigs I believe to be applicable to all other domestic animals; so that the cultivation and use of this root to a great extent would be a great benefit to society.

I filled a large cast-iron cauldron with carrots washed, and each cut into two or three pieces. I threw a little salt

salt in from time to time while filling the cauldron, a few sage leaves rubbed to a powder, and some dried thyme. The cauldron being quite filled with carrots, and having poured in a large glass of water which fell to the bottom of the vessel, I covered the whole of the surface with bran, which I took care to heap up. The cauldron being placed upon a great fire, the water rarified, and the bran heaped above, prevented the steam from escaping; the carrots were dressed in this steam, and in their own juice, and when the steam came through the bran in little wet holes on the surface, then the coction was accomplished. The smell of these carrots was so agreeable that the servants partook of a portion of them which they were giving warm to the animals, who likewise eat it with great eagerness.

By this single method I have fattened several pigs. Their flesh was excellent, and cost me two thirds less than that obtained in the usual way by leguminous and farinaceous food.

When I have employed farinaceous and leguminous food to fatten animals, I have had it bruised, and have fermented it with skimmed milk, dish water, and a little leaven; and this preparation fattens more speedily, and at a less expense than the best corn. This is the basis of all the secrets of the German fatteners of cattle. I have given these dressed carrots to my cows, and in five days I have observed that they gave much more milk than before, and of a better quality.

I gave carrots dressed in this way to a large bitch who nourished her young, and after some days her milk became more plentiful, and furnished cream, which I could never obtain before. This milk had not that acrimonious taste which I have always perceived in the milk of dogs fed upon meat.

The produce of the carrot may be put in competition even with that of corn.

By steeping the raw carrots in water to deprive them of their acrid principle, then boiling them, and afterwards bruising them, and making them ferment, an ardent spirit may be drawn from them, and the use of brandy of this kind might be authorized, and that made from rye prohibited, since it sometimes gives the epilepsy, and renders this disorder frequent in the North, as I have described in my " Médicine Maternelle."

Description of a new-invented Blow-Pipe for Enamellers, in which the Air necessary to supply it is produced by a new Method. By M. L'ABBE MELOGRANI.

With an Engraving.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

THIS instrument, which is as simple as it is convenient in its use, is adopted in the works of the royal cabinet of mineralogy at Naples. The description which its inventor gives of it, though very succinct, is yet sufficient to make its construction easily understood, especially with the assistance of an engraving, see Fig. 1, Pl. VI.

Two hollow glass globes, of a size proportioned to the effect required, are united by two metallic tubes placed one against the other.

Each of these pipes has a valve attached at each of its extremities; a third pipe placed horizontally, and at right angles with the two first, is hermetically fixed to the pipes which unite the two globes. This horizontal pipe, besides serving to direct the air upon the flame of the lamp, likewise forms a support and axis on which the globes turn.

When

When the lower globe, which is half filled with water, has, in changing its position become the uppermost, the water will run from A to B, through the pipe C, and will form by the pressure upon it a current of air in the pipe D, which being stopped by the valve at the extremity of this same pipe, will be forced to pass through the horizontal pipe E, the mouth of which being directed towards the flame, will produce the effect desired; when it has descended into the lower ball, the position must be changed, and the action of the machine will recommence, as has been described.

Description of a Syphon capable of raising Water to the Height of 30 *Feet, without any human Help, invented by* THEODORE PIERRE BERTIN.

With an Engraving.

From the BIBLIOTHEQUE PHYSICO-ECONOMIQUE.

A B C (Fig. 2, Pl. VI.) represents a common syphon, with a funnel D at the summit. When this syphon is used, care is taken to shut the two cocks E F, and to pour the liquor into the branches A C, through the funnel D, the cock belonging to which is afterwards shut. This operation done, the cock E of the branch C is turned, then the cock F of the branch A, and the instrument acts as a common syphon; that is to say, that the water from the source I takes its course through the orifice K of the ascending branch, and escapes through the orifice L of the descending branch.

As yet this syphon has only drawn the water from the source, given it another direction, and carried it below its own level. But, if we would have the water raised 28 feet above the source, it is only necessary to turn while

 the

the syphon is in play the cock M, leaving nevertheless a capillary opening. Then part of the water which rises through the orifice K of the branch C, descends by this little opening into the reservoir N, while the rest is lost through the orifice L of the branch A. If it be desired to draw the water from the reservoir N, the cocks M and O are shut, and the cock P is opened. This gives a passage to the liquid by its orifice Q, without interrupting the play of the instrument which, during this time, resumes its functions as a common syphon. We see therefore, that by this very simple method, water may be raised, without any human aid, above the level of any current whatever, provided this current have a little fall. The conducting pipe R, represented by the dotted lines, indicates that if, when the funnel syphon performs the function of a common syphon, the cocks M and O are so turned as to leave only a capillary opening, care being taken to keep the cock P of the reservoir shut, it will then act as a pump; that is to say, that the orifice S of the conducting pipe will draw the water from whatever places it may be confined in, and carry it to the reservoir N, from which it may be again drawn, by shutting the cocks M and O, and opening the discharging cock P.

This instrument is applicable to different purposes: as a syphon it may be used to raise water above its source in any situation. As a pump it may serve as a pneumatic chemical apparatus, by the help of which may be made acidulated waters, alkalies, &c. In fact, when the air passes through the orifice S in its way to the reservoir N, and afterwards to escape through the orifice L of the limb A, it may still be arrested in its progress, even when the reservoir L is half filled with water. If then some bits of iron are put in the bottle (fig. 3.) with some sulphuric acid, the gas which is disengaged will be drawn across

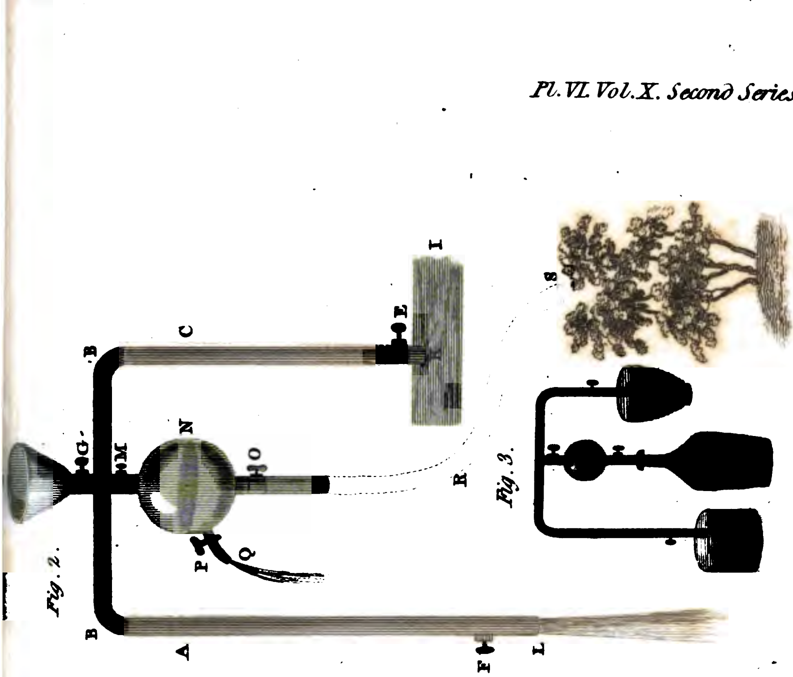


Fig. 2.

Fig. 3.

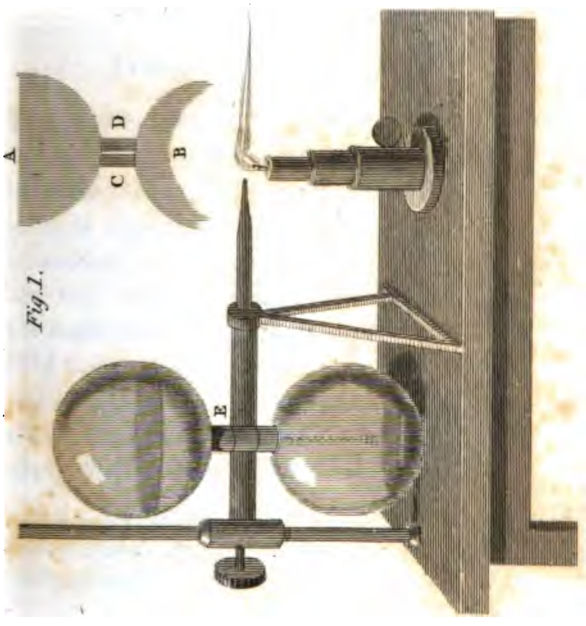


Fig. 1.

across the water of the reservoir, by the syphon's performing the functions of a pump; it will impregnate the water contained in the reservoir, and communicate to it its chemical qualities. This kind of pump, whose effects are in proportion to the superior length of the descending limb over that of the ascending one, is likewise very convenient for conveying perfumed or aromatic air, such as that of an orangery for example, into rooms; it may also be rendered useful for mild suctions*, and consequently might be used in numberless chirurgical operations where the sucking pump is employed.

Memoir on Roman Alum, compared with that which is manufactured in France. By Messrs. THENARD *and* ROARD. *Extracted by M.* BOUILLON LAGRANGE.

(Concluded from Page 79.)

THIRD ARTICLE — *continued.*

We have seen by the experiments contained in this article that the action of the sulphate of iron on the yellow of woad makes the colour green and dull; on cochineal it changes it to a violet, without altering it so speedily as it does madder; and applied to kermes, in particular, it heightens the colour without making it too dull; for persons not much used to compare colours, do not in general prefer it on woollen to those obtained by pure Roman alum, and those alumed with the same alum and $\frac{1}{15}$ of sulphate of iron; and of this we may be convinced by comparing Nos. 1 and 4 of the Experiments 36 and 39.

* It is easy to augment or diminish the suction, by turning the cocks with which the descending limb is furnished, and by means of which it may be lengthened or shortened at pleasure.

In

In the colours on cotton, whether the yellow of woad or sumac, or madder red, notwithstanding the slight variations occasioned by drying the mordant, the Experiments 44, 45, and 46, with purified Liege alum, and $\frac{1}{100}$ of sulphate of iron, have never produced colours deeper or more dull than the same experiments with Roman alum and $\frac{1}{100}$ of sulphate of iron.

The sulphate of iron acts in the most obvious manner upon silks; for the woad yellows and the cochineal crimsons are much more altered by $\frac{1}{100}$ of sulphate of iron than woollens are by $\frac{1}{25}$ of the same substance acting on the same colours.

Knowing the great sensibility of silk as a test of small quantities of iron, we made use of it to determine whether our alums contained only $\frac{1}{1000}$, as we found by synthesis, by pouring prussiate of potash into solutions of pure alum, altered afterwards by greater or less quantities of sulphate of iron.

We alumed some silks with alum free from iron, with the alums of Rome, Liege, Javelle, and Curaudau, and with similar quantities of the same alum pure, to which had been added from $\frac{1}{1000}$ to $\frac{1}{100}$ of sulphate of iron.

After colouring, we found in all the tints of experiments 56 and 57, produced by our pure alum, made more or less ferruginous, colours perfectly similar to those of our ordinary alums; thus the $\frac{1}{2000}$ of sulphate of iron, added to this pure alum, produced us, upon cochineal and woad, the colour given by Roman alum; the $\frac{1}{1600}$ that of the alums of Bouvier and Curaudau; the $\frac{1}{1200}$ like that of Javelle; and, at last, the $\frac{1}{1000}$ like that of Liege.

We cannot, therefore, any longer attribute the differences obtained in dyeing, by the different alums, to any

any other causes than to these infinitely small quantities of sulphate of iron; since, by the addition of this substance, we converted the purified alums, and that of Rome, into alums which offered us, by the re-agents, the same results as the most impure alums in the trade that are sold; and that, by the subtraction of the sulphate of iron, we can make at will, with the most impure alums that are made, alums that will produce colours as fine and finer than those obtained by Roman alum.

FOURTH ARTICLE.

Experiments on the Influence of Sulphate of Ammonia, and on Alum having a Base of Ammonia.

Many very distinguished chemists have advanced, on the authority of Bergman, that alums having a base of ammonia, produced in dyeing very prejudicial effects.

To assure ourselves that this opinion was well founded, we treated woollens and silks with different proportions of sulphate of ammonia, to which we added Roman alum, and with alum without potash, having the base entirely formed of alumine and ammonia.

$\frac{1}{100}$ and $\frac{1}{50}$ of sulphate of ammonia produced no sensible change in silks and woollens when in the colours of woad and cochineal.

$\frac{1}{25}$, $\frac{1}{12}$, $\frac{1}{6}$, $\frac{1}{3}$, of the salt gave a gradation of shades, in which the colour alumed with Roman alum and $\frac{1}{3}$ of its weight of sulphate of ammonia, is from two to three shades weaker than that proceeding from pure Roman alum.

After that we expected to perceive very sensible changes, with alum having a base of ammonia; but we found no difference between its effect and that of the Roman alum.

58th

58th Experiment, woad.		Woollens,	Sulphate of ammonia.
29th ——— cochineal.			
60th ———	silk, woad,		alum having an ammoniacal base.

Such are the facts which we submit to the Institute, on the question so long undecided, respecting the superiority of the Roman alum above all others. They presented us with an exact and perfect coincidence between the results of our analyses and our experiments in dyeing; they prove that to sulphate of iron has been attributed an action much too extensive, of which we have shewn all the influence, and made known the limits; and they particularly prove to us, that the opinions, perhaps formerly exact, on the exclusive advantages of the Roman alum, are no more than erroneous opinions, which theory has combated with success, and which even practice has demonstrated to be inaccurate. The immediate consequences of these facts are the following:

1. All alums contain exactly the same proportions of sulphuric acid, of alumine, of potash, and of water, though they produce sensible differences, and by the reagents, and in their application to the art of dyeing.

2. These differences only proceed from the unequal quantities of sulphate of iron contained in them, though amounting only to some thousandth parts, for they disappeared completely when the alums were purified; and they were re-produced to the same degree when the sulphate of iron, of which they had been deprived, was restored to them.

3. The Roman alum is that which contains the least sulphate of iron; the alums of Bouvier and Curaudau have rather more; but the quantity they contain is not actually appreciable but by the re-agents, and upon silk dyed

dyed with woad or cochineal; while prussiate of potash immediately discovers the presence of sulphate of iron in the alums of Liege and Javelle.

4. The Roman alum does not merit the exclusive preference that has been given to it, for we have obtained on woollen, cotton, and silk, with Liege alum purified by water, and even with the alums of Bouvier and Curaudau, colours as fine and as brilliant as those produced by the Roman alum; and whenever this last has appeared to us to be superior to the alums of Bouvier and Curaudau, we can assert that the difference has been so trifling, that none but experienced persons could perceive it.

5. The alums of Javelle, and especially of Liege, though they do not contain more than $\frac{1}{1000}$ of sulphate of iron, almost always produce colours less lively than those of the purified or pure alums.

6. This effect of sulphate of iron is not the same on all materials, and with all colouring substances; it is very sensible on silks coloured with woad and cochineal; it is a little less so on cotton; and it is still much less so upon woollen, with these same substances. The woollen appeared to retain a less quantity of sulphate of iron than the cotton, and especially than the silk, for the colours in woollen are less altered by $\frac{1}{25}$ of this sulphate, than those in silk are by $\frac{1}{100}$; and in all the colours of madder, *orseille*, and kermes, it required very large portions of this substance to regulate the tint, and sometimes even to deprive it of its rawness.

7. All manufacturers of alum therefore may, when they please, by simple means, and at a little cost, convert the most impure alum into such as may possess all the properties and advantages of the so much boasted Roman alum.

We hope that the importation of foreign alums into France, which deprives it annually of several millions, and which has already sensibly diminished, will soon cease entirely; that our manufacturers of alum, better informed of their true interests, will no longer seek to distinguish their goods by false appearances; that their care to furnish the trade with no alums but what are constantly pure, will soon cause the Roman alum to be forgotten among our manufacturers; and that at last our native alums, the alums of French manufacture, justly famous, will extend to foreign countries, and enrich France by a new and considerable branch of commerce.

Receipt for an elastic and permanent Dye and Varnish for Hats, Helmets of Felt, Gaiters, Boots, and Shoes; and which may also be employed with Success on Woollen and Linen Cloths.

First Operation.

IT is necessary in the first place to extract from hats and other articles of felt, whatever gum they may contain; this may be easily effected, by washing them in warm water, and gently pressing them. Before they are perfectly dry, they must be put upon blocks, to preserve their shape, and to prevent wrinkles, which is very essential. New leather as well as old requires to be scraped with a glass, to take from its surface the wax or grease with which it may be impregnated. Hard resin reduced to a powder, and laid on with a coarse brush, also clears it perfectly of the grease.

Second Operation.

All felt hats have a kind of down or nap, of which they should be cleared, by means of a dry pumice-stone; this

operation may be performed without taking the hat from the block, and every part where the varnish is to be applied should be thus deprived of its down. Leather should be cleared in the same manner, in order to erase both its natural inequalities and the marks left by the scraper.

The dry pumice-stone alone is used to clear woollen and linen cloths of their nap, as it does hats.

Third Operation.

The down being removed in the manner above mentioned, a coat of the black dye (to be described below) must be laid on the hats or other articles to be varnished.

They must be suffered to dry well upon the block, that they may not fall into wrinkles, which would prevent the equal distribution of the dye.

Fourth Operation.

When the first coat of dye is perfectly dry, the pumice-stone must be used (wetting it from time to time), in order to remove any inequalities which may remain.

Fifth Operation.

After waiting some hours, if the air be warm and dry, a second coat of the black dye may be applied, and polished in the same manner with the pumice-stone as before observed.

Sixth Operation.

The varnish (which will be described below) is used to give the finishing hand to the felt, leather, or cloth, taking care to employ for this purpose a fine and even pencil, that the varnish may be uniformly and equally spread.

When the first coat of varnish is perfectly dry, it must be sprinkled with pumice-stone reduced to a fine powder,

 and

and rubbed well all over with a wet sponge or piece of fine linen rag, of flax or hemp, also wetted.

To render the varnish perfectly smooth, tripoli soaked in a pint of oil, and rubbed on with the palm of the hand, may be used in the place of pumice-stone. At the second and last coat of varnish, it must be polished, when well dried, by sprinkling it with starch and rubbing it with a fine linen rag, which gives it a very fine lustre.

In case the varnish becomes tarnished or loses its lustre by any accident or by long usage, it may be restored by placing the articles in boiling water for one minute, suffering them to dry thoroughly, sprinkling them with starch, and rubbing them with a fine dry linen rag. They will then resume their former brilliancy.

Preparation of Linseed Oil, under the Denomination of Oil of Marmite.

Take Linseed oil		15 pounds.
Umber	-	4 ounces.
Red lead	-	1 pound 8 ounces.
White lead	-	2 pound 4 ounces.

Put the whole into a kettle placed over a strong coal fire; let it boil for 36 or 40 minutes, stir it from time to time with a wooden spatula, being careful that it is neither too little boiled, nor viscous from being too much.

When you take the kettle off the fire, throw into it a piece of bread, both crust and crumb, of the size of a roll. Cover it and leave it to cool for 24 hours. The oil thus prepared serves for various purposes.

Composition of the Black Dye.

1. Take of black umber 2 pounds 13 ounces, cut it into small pieces, and put them into a frying-pan upon a very brisk fire, and roast it like coffee for about three-

quarters

quarters of an hour; bruise it afterwards very fine upon marble, mixing it in the manner of painters with a little of the oil of marmite, and put this preparation into a stone pot.

2. Take of verdegris 3 pounds, reduce it to an impalpable powder; mix it with the oil of marmite, and then put it into the stone pot which contains the umber.

3. Take of lamp-black 1 pound, mix it also with the oil of marmite, put it into the same stone pot, and blend the whole well together.

This is the mixture used to dye articles of felt, cloth, or leather; observing with respect to leather that it is essential to give it previously two, three, and sometimes six coats of the oil of marmite; that it must be well dried each time, in order to extract from the leather the grease, wax, and fish oil, that the dye may more easily incorporate with it. This precaution must be taken with soft boots when placed on the blocks or boot lasts, and without taking them off, the different coats of dye and varnish may be applied to them.

Method of preparing the Varnish.

Take of Prussian blue	12 ounces.
Indigo -	12

Bruise these drugs separately upon the marble; mix them up with a little oil or spirits of turpentine, and put these ingredients into a pot by themselves.

Take afterwards gum copal	8 ounces.
Prepared nut oil	5
Spirit of turpentine	14

Put the gum copal, bruised, into a matrass with a large neck upon a strong fire without flame, being careful to stir it frequently and to keep it unstopped. It may be known

known that the gum is totally dissolved, when the smoke has entirely abated in the matrass; then some prepared nut-oil must be poured into it a little at a time, stirring the mixture each time that it is put for an instant on the fire, that the whole may be perfectly incorporated. Afterwards, and in the same manner, pour spirits of turpentine into it; and lastly filter this composition, let it cool, and it may be bruised with Prussian blue and indigo, in small quantities at a time, the whole being well mixed together.

This mixture forms the fine varnish proper for the purpose in question.

List of Patents for Inventions, &c.

(Continued from Page 80.)

JOSEPH MOSELEY ELLIOT, of the parish of St. James, Clerkenwell, in the county of Middlesex, Watchmaker; for a new or improved method of making and constructing repeaters, or repeating watches, and time-pieces. Dated October 30, 1806.

JAMES FREDERICK MATTHEY, of Suffolk-street, Charing-cross, in the city of Westminster, Lieutenant in De Meuron's Regiment; for various improvements upon fire-arms and guns of all descriptions.
Dated December 4, 1806.

SAMUEL WILLIAMSON, of Knutsford, in the county of Chester, Weaver; for an improvement in weaving cotton, silk, woollen, worsted, and mohair, and each of them, and every two or more of them, by looms.
Dated December 4, 1806.

WILLIAM

WILLIAM HYDE WOLLASTON, of the parish of St. Mary-la-bonne, in the county of Middlesex, Gentleman; for an instrument whereby any person may draw in perspective, or may copy or reduce any print or drawing. Dated December 4, 1806.

WILLIAM SPEER, of the city of Dublin, Esquire, now residing in the city of Westminster; for a new art, method, or process of purifying, refining, and otherwise improving fish oils and other oils, and converting and applying to use the unrefined parts thereof. Dated December 13, 1806.

THOMAS SCOTT, of Clerkenwell-close, in the county of Middlesex, Musical-instrument-maker; for an improved musical instrument called a flageolette English flute, or an instrument on the flageolette principle, so constructed as a single instrument that two parts of a musical composition can be played thereon at the same time by one person. Dated December 13, 1806.

AMBROSE BOWDEN JOHNS, of Plymouth, in the county of Devon, Bookseller; for certain compositions, and a mode of manufacturing the same, for covering and facing houses, and various other useful purposes. Dated December 22, 1806.

WILLIAM BELL, of the town of Derby, Engineer; for an improvement upon, and an addition to smoothing-irons, planeing-irons, and various edge tools, applicable to many useful purposes. Dated December 22, 1806.

ANTHONY GEORGE ECKHARDT, of Berwick-street, Golden-square, in the county of Middlesex, Gentleman, Fellow of the Royal Society, and Member of the Society of Haerlem in Holland; for certain improvements in the mode

mode of covering or inclosing books, whereby their contents will be secured from the observation of any person but the owner, and will also be preserved from injury. Dated December 22, 1806.

ANTHONY GEORGE ECKHARDT, of Berwick-street, Golden-square, in the county of Middlesex, Gentleman, and Member of the Royal Society of London, and of the Society of Haerlem in Holland, and JOSEPH LYON, of Millbank-street, Westminster, in the said county of Middlesex, Cooper; for a new method of manufacturing pipes for the conveyance of water under ground different to the present pipes. Dated December 22, 1806.

CHARLES SCHMALCALDER, of Little Newport-street, in the parish of St. Ann, Soho, in the county of Middlesex, Mathematical and Philosophical Instrument-maker; for a delineator, copier, or proportion-ometer, for the use of taking, tracing, and cutting out profiles, as also copying and tracing reversely on copper, brass, hard wood, card-paper, paper, asses-skin, ivory, and glass, to different proportions, directly from nature, landscapes, prospects, or any other objects, standing, or previously placed perpendicularly; as also pictures, drawings, prints, plans, caricatures, and public characters. Dated December 22, 1806.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LVII. SECOND SERIES. Feb. 1807.

Specification of the Patent granted to WILLIAM HYDE WOLLASTON, *of the Parish of St. Mary-le-Bone, in the County of Middlesex, Gentleman; for an Instrument whereby any Person may draw in Perspective, or may copy or reduce any Print or Drawing.*

Dated December 4, 1806.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Hyde Wollaston do hereby declare that my said invention is described in manner following; that is to say: My said instrument consists principally of two reflecting surfaces, so placed with regard to each other, as that one (which I will call the first) of the said surfaces shall be wholly or in part interposed between the eye of the artist and the paper, or other material on which the delineation of any object or view, or the copy or reduction of any sketch, print, or drawing, shall be intended to be made; and the said reflecting surface shall

be so inclined toward the other (which I will call the second) reflecting surface, that objects reflected by that second reflection may also be again reflected by the first, and may by that means be rendered visible to the eye after two reflections, when the sight is directed towards the said paper or other material. And, in order that the said paper or other material may be seen with the same eye, as well as the doubly-reflected object, I make the said first-mentioned reflector of such materials as shall permit the said paper or other material to be seen through the same; or otherwise I make the said first-mentioned reflector of materials not capable of transmitting the light; and in this case I do interpose the same in part only between the eye and the said paper or other material. In the former construction the first reflector may be a piece of plain unsilvered glass, which is capable of exhibiting the image of a considerably luminous object by reflection, at the same time that a piece of white paper or other surface may be seen through the glass, and the image of that object may be placed upon the said paper or other surface; but in case the object be less bright, it may not be thus seen by reflection from clear white glass distinctly enough to be delineated, and in this case glass that is blue, or of any other dark colour, will be preferable. But it is in general better to use for the first reflector a glass partly silvered, and to allow the paper to be seen through an opening in the silvering, or past the edges of the same by one portion of the eye, while the doubly-reflected object is seen in the silvering by the other portion of the same eye.

And I do farther declare, that my said instrument might also be made with surfaces, which act by what opticians call prismatic reflection; but that I do not give the preference to surfaces of this last description, because

cause when the reflected object is much illuminated it may thus be made too bright to allow the paper and pencil to be seen distinctly. The most convenient position in which the said reflecting surfaces may be placed with regard to each other is such, that the rays proceeding from the object, and falling on the first mirror, (which are known to opticians by the denomination of incident rays,) shall each severally be at right angles to that proportion of the same ray which after reflection proceeds to the eye, (and is known by the denomination of the emergent ray,) because in these circumstances the instrument will be adapted to drawing upon an horizontal surface. And in order that the same incident and emergent rays may be at right angles to each other, it is requisite that the reflecting surfaces should be inclined to each other at the angle of 45 degrees, as is shewn in Fig. 1, hereunto annexed (see Pl. VII.), or at an angle of 135 degrees, (which is the supplement of 45 degrees,) as is shewn in Fig. 2. *a b* in each figure is the section of a reflector, partly transparent and partly silvered. *m n* is the surface of the same glass, and *o* the part silvered. *c d* in each figure is the section of a glass wholly silvered. When prismatic reflection is employed, the angle of the reflecting surfaces to produce a like effect must be 135 degrees, as in Fig. 3, which represents the section of a solid prismatic piece of glass, in which both reflections are made, and the reflecting surfaces *a b* and *b c*. The angle at *b* is 135 degrees, and the angle at *d* 90 degrees; and the angles at *d* and *c* may be each 67½ degrees, but need not necessarily be equal. In each of these figures *e* is the eye to which a ray *h g*, after being reflected at *g* and *f*, passes on in a direction *f e* at right angles to *h g*. The glasses, or other suitable reflecting surfaces herein before described, when properly mounted, and supported at a

convenient distance from the paper or other material upon which the said delineation, copy, or reduction is to be made, do, together with the necessary framing, (which every competent workman may easily make of a variety of forms without farther instruction,) constitute the whole of my said instrument, adapted to the use of persons who can with facility see both near and distant objects; but for persons who are short-sighted I place a suitable concave glass before the distant object, so as to receive and transmit the incident rays; and for long-sighted persons I place a suitable convex glass between the eye and the said paper, or other material.

Fig. 4 represents the section of a pair of reflectors at angles of 45 degrees, to be mounted in a frame which carries one convex glass *i k*, and another concave glass *m n*, which turn upon the same hinge at *l*, so that either of them may be turned into its place for use. In the position here given the convex glass is supposed to be employed, and the line *o p* represents a ray by which the paper and pencil are seen at the same time that the object is seen by rays reflected through *h*, *g*, *f e*, which render the same visible in the direction *e f*. The said convex and concave glasses may conveniently be made of the focal length of twelve inches; and the instrument must then be supported at the distance of twelve inches from the paper.

In witness whereof, &c.

We are requested to add, that the Patentee has appointed Mr. Newman, of Soho-square, to manufacture and vend the above-described instrument.

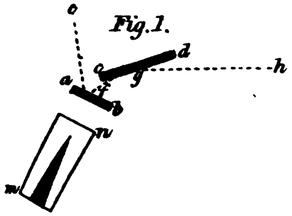


Fig. 1.

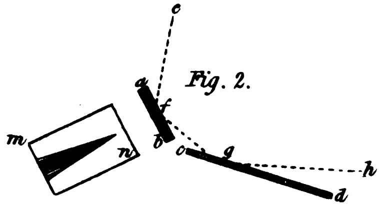


Fig. 2.

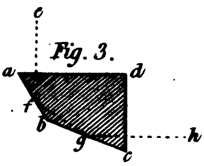


Fig. 3.

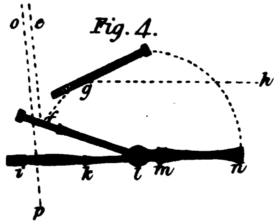


Fig. 4.

Fig. 5.

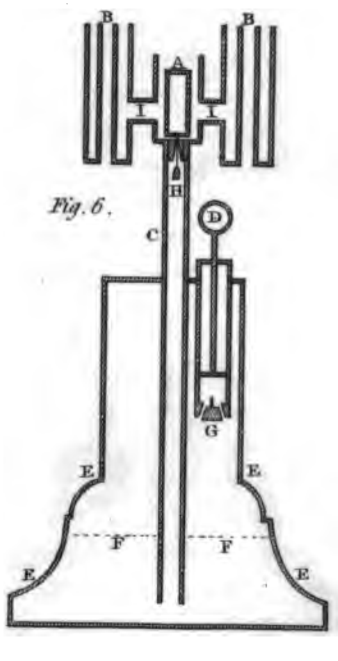


Fig. 6.

Specification of the Patent granted to ROBERT VAZIE, *of St. Mary, Rotherhithe, in the County of Surrey, Civil Engineer; for Improvements in the Measures and in the Machinery to be used in making Bricks and Earthen-Ware; and also Improvements in the Carriages for removing the said Articles; which said Improvements are separately applicable to various other useful Purposes.*

Dated November 6, 1806.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Robert Vazie do hereby declare that my said invention is described in the drawings in the margin hereof, and in the description following; that is to say:

Part I. To adjust the quantity of coals to be used in burning bricks and in baking earthen-ware, I do place upon the outside of the coal-bushel measure with which I measure the said coals, a moveable semi-circular metal bow, upon which I suspend three moveable bobs or pins of metal, or other material, so as to form three guages A B C, Fig. 4, (Plate VIII.) of such a due length, and at such a distance from each other, that when the measure is filled with coals to the height of seven inches perpendicular above the centre of the plane of the top of the measure, the lower part of the guage A is equal to the due height of the heap, and the lower part of the guages B C comes in contact with the straight side of the heap at a mean distance from the top of the heap to the outside of the measure; which heap is as nearly in the form of a cone as the nature of the coals will permit, the

the outside of the measure being the extremity of the base thereof; to prove the regularity of the sides of the said heap on each side of the bow when placed perpendicularly, I apply thereto a straight rule, of metal or wood, or both, at least as long as the side of the cone. The bow and the guages are turned down by means of the hinges D D, and lie on the outside of the measure at the time of filling it. The bow, the guages, and the rule, can be applied to any other perpendicular height of the heap besides seven inches, and may with utility be used upon measures of greater or less diameter, or of any other denomination besides the said bushel measure; in which cases a proportionate difference must be made in the length of the bow, the guages, and the rule, and also in the distance at which such guages are placed from each other, so that the side of the heap upon each respective measure shall be of equal declivity with the heap upon the bushel measure at the time being. The said bow with the guages might be applied to adjust the heap without the rule; or the rule adjusted to the due length of the side of the cone, as *per* Fig. 5, may be applied on each side, and every side of the heap, without the bow and guages; in the latter case, the rule will both adjust the side of the cone, and form a standard for the perpendicular height of the heap. Measures thus adjusted may be usefully applied to the admeasurement of coals for household use, and the other purposes for which coals are used; and also for the measuring of grain, fruit, roots, and such other articles as are usually disposed of by admeasurement.

Part II. To raise the water to be used in tempering and preparing clay, or other materials, for making bricks and earthen-ware, I apply in preference to a pump with one piston or bucket a pump with two or more pistons

tons or buckets, in the following manner, *viz.* Upon a bar of wood or iron, called a spear or rod, I do fix the uppermost piston, upon the underside of the said piston I do place an eye of iron, or other metal, and by means of a hook, at the upper end of a separate bar of wood or iron A, (upon which bar I fix the undermost piston,) the different pistons are connected together *per* B C, Fig. 6. The distance between the said pistons is two feet; and every thirty feet the water is to be raised, I apply two pistons thus connected together, which rise and fall at one and the same time by means of a lever, or other machinery usually applied for that purpose. In order to prime the said pump in case there is more than one set of pistons applied, I place the funnel or small cistern D at a short distance above the lowest set. In the pipe which connects the said funnel with the pump I fix a cock of brass or other fit material, and in place of one plug I apply in the said cock the two plugs E E, or two separate cocks may be fixed in the said pipes. The pistons may be placed at a greater or less distance from each other than is hereinbefore described, and may be connected together by hinges of different constructions, or may be fixed upon a rod passing through the different pistons with or without a fixed joint upon the said rod. The box or boxes in the lower chamber of the pump, also the valves upon the said box or boxes and upon the pistons, may be applied in any usual manner. Pistons thus connected together may be also applied usefully in a pump to raise water from a mine, shaft, pit or quarry, or the hold of a ship, or reservoir for general purposes, or for compressing or exhausting air or steam; and the cock may also be usefully applied to retain or draw off liquid matter from a pipe, cask, or reservoir, or a boiler or vat.

Part

Part III. In the removal of bricks and earthen-ware with carriages engaged on hire, in the day time, I do place in a convenient situation upon and near the top of each and every such carriage, a signal when the carriage is unhired. The signal is placed perpendicularly, and is placed as *per* Fig. 7 ; and when the carriage is hired the said signal is turned down by means of a joint at A, (similar to the joint of a clasp-knife,) and lies horizontally. In the night-time I do place in a similar situation to that before described, a lanthorn, containing a lamp or other light. When the carriage is unhired, the light appears through certain characters cut in a shutter, as *per* Fig. 8 ; and when the carriage is hired, the said shutter is turned down by means of the hinges B B, when the light alone, without any characters, will appear. One or more day or night signals, to answer the above purposes, may be exhibited on one or more sides thereof, on each and every such carriage, in any other conspicuous situation, form, or description on metal or other materials, and may also be affixed with advantage on hackney-coaches, stage-coaches, and other carriages usually engaged on hire: or the day signal may be exhibited on the person of the driver, or upon the outside of each such carriage when unhired, and concealed when hired.

A farther improvement in such carriages consists in reducing the friction of the wheels. To effect this, I do use in the boxes of the said wheels (in preference to common oil or other oily substance) oil prepared in the following manner, to free it from heterogeneous matter, which renders it viscous or tenacious, *viz.* I take whale-blubber, and put it into a pan (with a moveable cover) of copper or other metal. This pan is placed upon a boiler, and by the heat of the steam arising therefrom when boiling the oil is extracted. The oil is then put into a separate

a separate steam-pan with water, and is there purified. The aforesaid boxes may be made in any of the methods in use for retaining oil. I also burn the said oil in the signal lamps before described, because it affords a strong light, and leaves little or no incombustible matter in the lamp. This oil may be used with advantage in the boxes of the wheels of other carriages, or burnt in other lamps, and is applicable to various other useful purposes.

In witness whereof, &c.

Specification of the Patent granted to HENRY PRATT, *of Birmingham, in the County of Warwick, Steel Toymaker; for a Toast-stand, or an Improvement on the Article commonly called Cats or Dogs, upon which Things are placed before the Fire.*

Dated October 2, 1806.

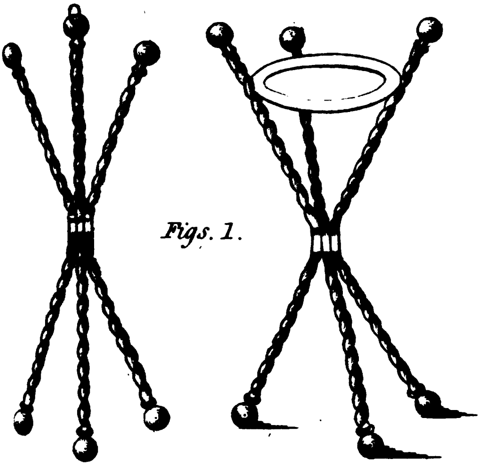
With Engravings.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Henry Pratt do declare that my said invention of a new toast-stand, or an improvement on the article commonly called cats or dogs, on which things are placed before a fire, is described as follows; that is to say: Instead of the legs being screwed, as in the usual way of constructing cats or dogs, to a ball or centre-piece, I substitute one, two, or more joints, with one or more stops, to form proper angles, or I make them with fixed joints, by means of one or more pins or rivets passing through the joints. The joints which I substitute instead of screwing the legs into the centre-piece, are described as follows; in the article commonly called a cat,

 (see

(see drawings Fig. 1, Plate VIII.) it is about one inch more or less diameter, with a hole made through the centre of each joint to admit a pin, on which the centre joint moves. Another hole is made in each outside joint halfway between the centre hole and the outside of the joint through which another pin or rivet passes, to fasten the outside joints to keep them from moving. The centre joint, has a groove made in it about half an inch long, making about the third part of a semicircle. The pin that fastens the two outside joints together passes through this groove, making a stop, and forming a triangle when open. The joints which I substitute for the article commonly called dogs, (see drawings Figs. 2 and 3,) in the diameter of the joints the centre pin and middle joint are the same as mentioned in the description of the cat; and in each of the outside joints I make a groove, similar to the one described in the middle joiut of the cat. These groove are opposite to each other. A pin passes through these two grooves and the centre joint, making the stop, and forming the triangle when open. When required, I attach a fork to these stands, for the purpose of toasting. This fork is attached in the following manner: the middle leg of the upper part of the cat or dog I make hollow, into which I make to slide a small handle with a toasting-fork, made to spring in the prongs, which, when drawn out of the tube by means of a joint, falls in an horizontal position, and forms a toasting-fork. These articles are made of any kind of metal, or compound of metals, of sufficient stiffness, or of wood.

In witness whereof, &c.



Figs. 1.

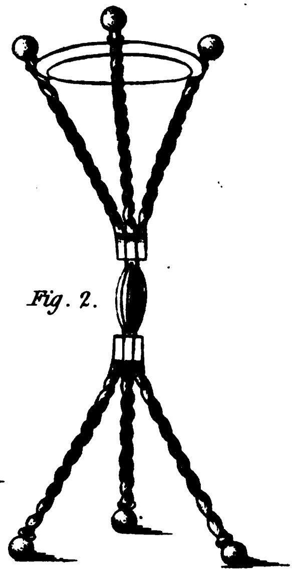


Fig. 2.

Fig. 4.

Fig. 5

Fig. 6.

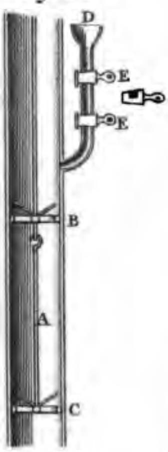


Fig. 7.

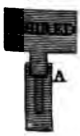


Fig. 8.

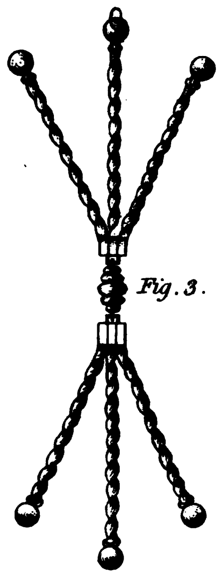


Fig. 3.

Specification of the Patent granted to WILLIAM NICHOLSON, *of Soho-square, in the county of Middlesex, Gentleman; for various Improvements in the Application of Steam to useful Purposes, and in the Apparatus required to the same.* Dated November 22, 1806.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Nicholson do hereby declare that my said invention, and the manner in which the same is to be carried into effect and practice, are described as follows. I convert water into steam by the application of heat in any of the usual and well-known methods, and permit the said steam to rush out through one or more apertures, of such magnitudes respectively as may be best adapted to the several intended purposes. And I do permit the current or currents of steam to pass through a portion of the atmosphere, or of air communicating with the atmosphere, or of such other gas, or elastic fluid, or vapour, or smoke, as it may be desirable should pass along with the said steam.—And farther, I do dispose a tube or pipe (of a circular bore in preference) in such a position, with regard to the said current or currents of steam and air, or of steam and gas, elastic fluid, or vapour, or smoke, as that the said current or currents shall pass through the said tube or pipe, and be carried to its place of destination. And I do give unto the said tube or pipe a greater diameter, or size of perforation, than I allow for the first escape of the steam from the place where the same was produced; and I do make the said tube or channel either cylindrical or of such other figure internally as may be best suited to pro-

duce that effect which is well known to men of science by the name of the lateral action of fluids, and is described in many books, particularly in some writings of Professor Venturi, which have been inserted in a periodical work called the Philosophical Journal, which has been for a number of years published in London, and acknowledged by me as the editor thereof, and the effect of which said lateral action of fluids is particularly to be observed in the ancient and well-known machine for producing a blast by the fall of a shower of water through an upright pipe; and in my said invention the lateral action of the current of steam doth take place with regard to the surrounding air, or gas, or elastic fluid, or vapour, which is carried along with it, so that the steam is made to produce an effect of the same nature as, but more powerful and advantageous than, is produced by the water in the said ancient machine; and I do apply the said current of steam and air, or of steam and gas, elastic fluid or vapour, or smoke, to such purposes of manufacturing or philosophical chemistry as may be useful according to the nature of the several cases respectively, namely,—(1) for agitating, or for impregnating, or for driving over in distillation water or other fluids, or (2) for oxidating, corroding, rusting, or altering the nature and state of lead or other metals, or metallic ores, or mineral bodies, more or less heated or ignited by the action of fire in tubes, or muffles, or tests, or bodies, or vessels, or upon hearths, grates, or otherwise so placed, situated, or exposed, as may be best adapted for the changes intended to be produced in the said metals, metallic ores, or mineral bodies, by means of the said current herein before mentioned and described; or (3) I do cause the said current of steam and atmospheric air to pass through the tube or pipe herein before

before described, or in some cases simply through an aperture or hole, into a receptacle or air vessel, wherein the steam is subjected to condensation, and from which vessel the atmospheric air, thus deprived of its steam, is conveyed to a furnace or any other place containing fire or burning materials, in order that the said current or blast of air shall and may excite and increase the strength, rapidity, and effect of the combustion.—And in order that my said invention may be more fully understood, I have hereunto annexed certain drawings or sketches of some of the forms of the apparatus, by means of which the same may be carried into effect.

In Fig. 1, (Plate IX.) *a* represents a pipe, through which the steam passes out from a boiler, or any other apparatus, whence it proceeds through the tube or pipe *d d*, carrying along with it a large portion of common air, which enters through the side spaces *b b*; and this mixed fluid mass passes thence through *c c*. If the surrounding part of the pipe or channel *d d* be made hollow, so as to form a space *d d*, enveloping the bore *c c*, and the hollow part *d d* be made to communicate with the boiler or general supply of steam, (without allowing any portion to escape by such communication,) the said surrounding part *d d* will be kept very nearly as hot as the steam itself, and the internal current will not be cooled by the sides of the said tube or pipe. Or otherwise, the said tube or pipe *d d*, if made of fit materials, may be kept at any required temperature by surrounding the same with fire; or, on the contrary, if need be, with some cold fluid or other refrigerating substance. In this, and in all the other apparatus, the aperture of *a* must be of such a size as shall be best adapted to the intended emission of steam, of such elasticity and temperature as may be best suited to the objects in view; and so likewise

must

must be the diameters, form, and relative situation or distance of the tube or pipe *d d*: and since the said circumstances are themselves in their own nature variable, it is not possible for me to give any farther instruction respecting such dimensions and situations, than by declaring that a few trials will easily shew what will be most advantageous to be adopted in each particular case.

Fig. 2 represents an improvement of the ancient water blowing machine; in which, in its usual construction, a shower of water carries air down an upright pipe into a regulating belly, as is described in the writings of Lewis, Chaptal, and many other well-known authors of reputation. I have introduced the water from a head, or under any other pressure through *d*, into the close chamber or box *e e*, which surrounds the tube or channel *b b*, *c c*, and supplies the water through side apertures towards *c c*. Air may also, if required, be allowed to pass through other side apertures as usual. In my improvement, a current of air and steam is strongly urged through the tube or pipe *b b*, by means of the current of steam from *a*, in the same manner as was explained and described in Fig. 1. In this, as well as in the other applications, the steam may be allowed to pass into the tube or channel through more apertures than one. As the lower part of the said improved blowing machine, Fig. 2, consists, as usual, of an air vessel of that description, which is called a regulating belly, the same need not be described, because it is well known by that name, and constitutes no part of my said improvements.

Fig. 3 exhibits a sketch of the manner in which my apparatus may be constructed and disposed for producing a very strong blast by steam. *m* represents the boiler, from which steam is supplied through the pipe *a a*, whence it

it passes into an air vessel *n n*, through an aperture at *b*, or through a tube or pipe *b c*, which favours the lateral action, and suffers the air and steam to pass into the water *e e*, whence the air rises into the upper space *f f*, and passes out through *g g*, to the furnace *k*. Cold water is introduced in the manner shewn in Fig. 2, or otherwise, through a pipe *dd*, from a head sufficiently elevated, or by means of a forcer, or otherwise, by means of a separate receptacle, as is hereinafter described and explained. *h* is a pipe or tube through which the heated water is suffered to escape, but is subjected to a resistance or reaction, arising from the same being wiredrawn through a cock, or impeded by a loaded valve, which it must lift during its escape, or by the said water being conducted up to a proper elevation through a continuance of pipe, as represented at *i*. It will easily be understood by workmen or operators, who are conversant with hydraulic or other similar works, that the pressure or reaction within the air vessel may be adjusted to any desired quantity or force by means of these two communications, or by other well-known methods. At *c* the upright tube or pipe is represented as terminating in one or more valves. These are not essentially necessary, but they are useful to prevent the water from returning suddenly through *b* if at any time it should be found necessary to stop or suspend the supply of steam.

When the supply of water at *d* cannot, with convenience, be made by pressure from an upper reservoir, and the labour of forcing the water in by a pump, or by other powers not dependant on the engine, is wished to be avoided, I sink or depress the air vessel *n n* to a sufficient depth below the level of that supply of water which shall or may be obtainable on the spot, and by that means I gain

gain a sufficient length in the pipe *d* to produce the requisite pressure, which will scarcely ever require to be greater than ten feet; and I bring the discharging pipe *h i* up again near the surface so as to allow the water a difference of level sufficient to produce the requisite current, and in this case I convey the steam-blast to its place by lengthening the pipe *a a*, or (which is better) by lengthening the tube or channel *c b* above the top of the air vessel *n n*.

Or otherwise, in the like cases, when the supply of water at *d* cannot with convenience be made by pressure from an upper reservoir, and the labour by forcing the water in by a pump, or by other powers not dependant on the engine, is wished to be avoided; and the last-mentioned contrivance, of depressing the air vessel, is inconvenient or impracticable; then I introduce the water in separate or distinct quantities or portions, from a separate receptacle or close vessel, placed a little above the level of the water *e e*, Fig. 3.

This receptacle must be provided with two cocks or valves, or a cock with several passages or ways through the same, in such a manner as that a communication shall be made for filling the said receptacle from without, at the same time that no communication shall be allowed between the air vessel *n n* and the receptacle or vessel now to be described; and also, as that, in other positions of the said cocks or valves, or cock, a communication shall be made for emptying the water from the said receptacle or vessel into the air vessel at the same time that no communication shall be allowed from without.

As the alternate filling and emptying of a vessel in the manner here described, is performed, with regard to steam, in a variety of steam-engines, and must be quite familiar

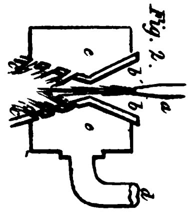


Fig. 2.
a
b
b
c
c
d

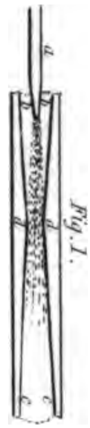


Fig. 1.
a
c
c

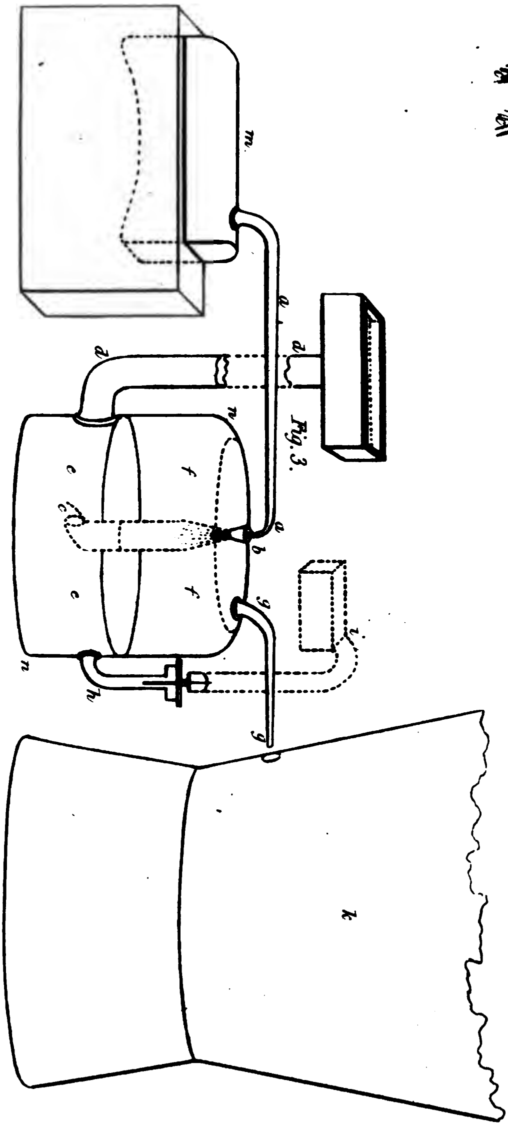


Fig. 3.
m
a
a
a
b
d
d
e
e
f
f
g
g
h
i
k
n
n

familiar to engine-makers, it will only be needful to remark, 1, that the opening and shutting of the said cocks or valves, or cock, may be most conveniently performed by a float within the air vessel, or within the separate receptacle, having a tail of communication which shall open and shut the said cocks or valves, or cock, at the times of the greatest rise or fall, by an action similar to that of the plug-bar, or equivalent gear of a steam-engine; and, 2, that the said rod, if intended to operate out of the said vessels, may be passed through a stuffing-box; and, 3, that provision must be made, by ways through the cocks, or by other well-known methods, to allow air to introduce itself from the air vessel into the receptacle while the water is discharging from this last; and also to allow the said air to escape, while the receptacle shall receive a fresh supply from without.

And lastly, I do declare, that the forms, dimensions, relative magnitudes, situation, and other particulars relating to the apparatus, required to carry my said improvements into effect, are capable of great variations, and will require to be greatly modified, according to the conditions, objects, and purposes intended to be answered and obtained, and the local and other circumstances under which the work is to be performed; but that the said forms, dimensions, magnitudes, situation, and other particulars, may, from the description and explanations herein given, be determined with facility by any person of competent skill, and fit to be entrusted with the direction and construction of any apparatus of this or the like description.

In witness whereof, &c.

Specification of the Patent granted to George Barton Alcock, *of the City of Kilkenny, in that Part of the United Kingdom of Great Britain and Ireland called Ireland; for Improvements in Lamps.*

Dated January 23, 1806.

With an Engraving.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said George Barton Alcock do hereby declare that my said invention is described in manner following; that is to say: My first improvement in lamps consists in giving a supply of oil to a lamp from beneath by means of a piston fitted to a tube.

Fig. 5 (Plate VII.) represents a lamp, of which E has the form of a candlestick, or any other form which may be most convenient or agreeable; and C D is a tube representing a candle, but which may be externally of any other figure, provided its interior part or bore be cylindrical, or of such section as to fit the piston hereafter mentioned through all that part where the motion is to be performed. Now I apply and use in the said tube the piston B, which is capable of being slided upwards or downwards within the bore of the tube, and its motion may be governed by a rack G and pinion F, or by a simple sliding piece, or other well-known contrivance. When the piston B is drawn down nearly to the bottom of the tube, oil is poured into the space A B above the piston, and the lamp, consisting of a cup and wick-holder, or any other of the apparatus constituting lamps, is to be screwed, fixed, or applied at A. A short movement of the piston will force a sufficient quantity of oil into the cup to supply the combustion; and the same motion may

may be repeated as often as oil shall be wanting. By this means the wick is supplied in a simple and expeditious manner.

My second improvement consists of an apparatus for affording a supply of oil from below to a lamp or lamps placed above; which supply shall be regular, notwithstanding any irregularity or excess in pressure beyond what is necessary to raise the oil to the due height. In Fig. 6 E E represents a vessel containing oil as high as F F, and air is condensed into the upper part of its cavity by means of the syringe D G. The pressure of this included air would force the oil to rise through the tube C and pass out, if it were not prevented by the valve H, which opposes any escape upwards. B B represent the section of part of two lamps of Argand, and any other lamps may be substituted in their place; they are supplied with oil by the side tubes I I. A represents a float or piece, which in this drawing is made cylindrical: it is so light as to float in oil. Now it will be easily understood, that previous to the condensation of air in E E (the whole of the oil being in that lower vessel) the float A will rest upon the bottom of the chamber or cavity in which it is placed, and the valve H, which is attached to it, will be open; so that, when the condensation begins, the oil will rise through C and H and I to nearly the same level in the two lamps and in the chamber of A, but when it hath risen so high as to float A, the valve H will be shut, and the lamps will be limited to the consumption of the oil which has already passed. And again, since that consumption will lower the level in the chamber A, the float will again descend, and admit a farther supply; and these spontaneous alternations of opening and stopping of the valve H will be so frequent that the same level will nearly be kept. It is obvious that,

in order to obtain that level which upon trial shall be found the best adapted to the lamps which may be used, it will be requisite to adjust the weight of the float and the condensation of the air respectively, so as to produce the desired effect, which also may easily be done by trial. It may also be noticed, that the pressure of gravity, or of a heavier fluid than oil, or of any other well-known agent capable of effecting the purpose, may be used instead of that of condensed air in the lower vessel.

And I do farther declare, that in such cases as convenience or choice shall give the preference, a stop-cock, or any of the well-known contrivances for the transmission of fluids, which can be opened or shut by a float, may be used instead of the valve H.

In witness whereof, &c.

Description of a Geometrical Plotting Quadrant, Level and Calculator, for the Use of Navigation and Land-Surveying; ascertaining inaccessible Distances, and for demonstrating and determining various Problems in Geometry and Trigonometry. By Mr. ROBERT SALMON, *of Woburn.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal and Ten Guineas were voted to Mr. SALMON *for the Invention; and the Instruments are preserved in the Society's Repository, for the Inspection of the Public.*

With a Plate.

ON the instrument and parts thereof, are engraved the names given by the inventor, and made use of in these explanations; the *base* line being that at right angles with

with the 90 degrees on the *arch*, as it is also to the *perpendicular*, which perpendicular always moves parallel to the 90 degrees. For the use of land-surveying, where the instrument can be made stationary, the sight (marked *a*, Fig. 1, Plate X.) with the small hole in it, must be applied; but for sea-service, the one *b*, Fig. 2, with the mirror, must be substituted in its place.

Every person who has had occasion to describe or calculate the parts of the right-lined figures used in geometry, perspective, surveying, navigation, dialing, architecture, &c. &c. must have perceived, that all of them are resolvable into the most simple of figures, a *triangle*, or some number of them.

Hence the great importance of geometry and trigonometry, in teaching, either by construction or calculation, the knowledge of all the properties or relations between the three sides and three angles, of which every plane triangle is composed. Euclid having demonstrated, in the fourth proposition of the sixth book of his Elements, that in any two *similar triangles* (by which he means their having the same angles, without regard to the actual lengths of their sides, for one triangle may be very small and the other ever so large) every pair of the corresponding sides in the two triangles are proportional; it is the business of trigonometry to solve such problems, with the help of the tables of sines and tangents, or of sectors, sliding or other rules, and scales, by which you can find, on inspection, a *right-angled* triangle, exactly similar to any given right-angled triangle, (or having one of its angles equal to 90°) which can be proposed, or can occur in practice; and by the rule of three we say, *as* any side of the tabular triangle *is to* the similar side, supposed to be known, of the triangle under consideration, *so is* any other side of the same tabular triangle, *to* the correspond-

ing

ing side supposed to be sought, of the triangle in question. It is evident, that by means of the *base line*, *perpendicular*, and either the *upper* or *lower limb* of my instrument, by the two motions of which the *perpendicular* is capable, and the angular motion of which the *limbs* are capable, any right-angled triangle whatsoever, as C B E, or C D E, in the diagram Fig. 6, (Plate X.) may be instantly formed (by bringing the top corner of the *perpendicular* to touch the *limb)* with the same or greater facility than it could be taken out of a trigonometrical table, measured by the compasses on the sector, or set on any instrument now in use for that purpose. But no instrument that I have seen or read of is capable of forming immediately *any obtuse-angled triangle*, as on my *geometrical plotting quadrant* can be done; nor can the trigonometrical tables be applied, to produce the sides and angles of such a triangle without some trouble in any case; and in some of the most useful cases in practice the labour is very considerable. I shall therefore give the solution of five problems. First; supposing that Fig. 6 (Plate IX.) represents my instrument, set to answer this and the following problems: A B C being the triangle under consideration; then since the ∠ A C E is by Euclid (I. 20) equal to the ∠ B A C, it is evident that this angle will be shown, or may be set, by means of the divisions on the arc F G; also, that since C B E and I C B are also equal, the *arc* H I, with the addition of 90°, (for the angle E B A,) will show the ∠ C B A of the triangle; it is equally evident, that the *arc* F H will show the sum of the two ∠s B C A and A C F, at the same time that the lengths of all the sides may be read off on the divisions or scales on C A, C B, and B A. Therefore,

First.

First.—*To construct or set a triangle, having two of its angles and the side between them given,*

Set the limb C G to the division at G upon the *arc* answering to one of the angles, say A, and make it fast; then to this ∠ A add the other given angle (which we will call C,) and set *the other limb* C H, and make it fast at the division H, on the arc answering to the sum of their degrees; then on the *limb* C G seek the length of the given side C A; next push the *perpendicular* up or down till the *parallel* cuts the point A, (always observing the divided edges are those you work to,) and by the help of the mill-headed *nut* move the *perpendicular* till its top corner just touches the *limb* C H, say in the point B; when it is evident that the degrees on the arc H I, added to 90°, is equal to the angle B, and that the other sides C B and B A may be read off thereon. Or supposing C B D to be the triangle, whose angles B and C and side B C are given, we have only to move the *limbs* so as to make I H equal to B, and H G equal to C, and then to bring the top of the *perpendicular* to touch C H at the division B, answering to the side C B when the other ∠ D will be shown by the division on the *arc* G F, adding 90 thereto; and the remaining sides C D and B D may be read off on their respective scales.

Second.—*To set a triangle, having two sides, and the angle included between them given.*

Let A B C be the triangle, A B and A C the given sides, and A the given angle; first set the *limb* C G to the division answering to A, then bring the *parallel* up to the point A, answering to the side C A, and by the *nut* move the *perpendicular* till B A answers to the given side B A; next bring down the *limb* C H to touch B, and

and on C B may be read the other side, while H G will show the angle C, and I H + 90° the ∠ B, whence all the six parts are known.

Third.—*To set a triangle, having two sides, and an angle opposite to one of them given.*

Let A B C be the triangle, A C and C B the given sides, and A the given angle; first read the ∠ A on F G, and set the *limb* C G thereto; then push up the *parallel* to the division at A, answering to C A, and with one hand work the *nut* and with the other move the *limb* C H till they touch at B, the division answering to the side C B; then B A is the side sought, and the arc G H will show the ∠ C, and I H + 90° the ∠ B.

Fourth.—*To set a triangle, having two angles, and a side opposite to one of them given.*

Let A B C be the triangle, A and C the given angles, and B A the given side; first set F G to the ∠ A, and G H to the ∠ C, then push the *perpendicular* up or down with one hand, while the other works the *nut*, till the given side B A, on the *parallel*, is applied exactly between the *limbs* C H and C G, then I H + 90° will show the remaining angle B, and on C B and C A may be read the lengths of those sides.

Fifth.—*To set a triangle, whose three sides are given.*

Let A B C be the triangle; on the limb C H seek the point B, answering to the side C B; then using one hand to move the perpendicular and the other to turn the *nut*, let an assistant at the same time, with his right hand, gently move the *limb* C H, while you cause the top corner of the *perpendicular* always to touch the point B; at the same time let the assistant move the *limb* C G with his

his left hand, till the lengths of C A and B A, on their respective scales, are found to intersect each other, when F G will show the ∠ A, G H the ∠ C, and H I + 90° the ∠ B.

My solution to the last problem is inferior to the common method of plotting the triangle on paper, and measuring the angles with a protractor; but I have introduced it here, to shew that my instrument is capable of solving this, as well as all other cases of obtuse-angled triangles, and might, by extending the *arc* to a semicircle, as shewn by the dotted lines on the figure, solve any triangle. In the practical problems in surveying, which follow, the triangles can always be taken right or obtuse-angled; and the instrument as at present constructed is fully competent. I might here add, that a given line can readily by my instrument be divided into any number of equal parts; drawings might be enlarged or diminished, as readily as with the proportional compasses, and many other equally useful purposes may be effected thereby.

First.—*To measure an inaccessible distance, by a perpendicular line set off towards the right hand, from the line or base between the observer and object.*

Set the *base-line* of the instrument in a line pointing to the object, at the same time place a staff at any distance at pleasure, as a perpendicular (being 90 degrees from the base). On this perpendicular measure any distance (say 50 yards or other measures) as a second station; move the instrument to this distance, and place it with its *perpendicular* in the same line as before; the instrument being so placed, set the *lower limb* pointing to the object, and with the screw make the same fast; this done, the dis-

tance of the object will be thus readily known. Raise the moving *perpendicular* of the instrument to the division 50, (as before suggested,) then with this height move the same by means of the *nut*, till the extremity intersects exactly the *lower limb* before set, at which intersection the distance from the second station will be shown; and on the *base line* will also at the same time be seen the distance from the first station: this is a case of right-angled triangles.

Note.—As the divisions on the *perpendicular* are denominated, (either feet, yards, poles, or other measures,) so will the distances be indicated on the other *limbs*, and on the *base* of the instrument.

Secondly.—*To determine the distances of any two inaccessible objects, both objects lying in a right line from the observer.*

As before directed, place the instrument with its *base* in the line of the objects; then, by means of the *upper limb* set at 90 degrees, place a staff as a perpendicular at any distance at pleasure (say 50 as before). This done, remove the instrument to this second station, and place it so that the *upper limb* (still at 90°) may be in the same line as when at the first station: this done, move the *upper limb* into the direction of the nearest, and the *lower limb* into the direction of the most distant object; which *limbs* being so set, and made fast, the distance of both objects from the second station will be seen on the two *limbs*, and the distance from the first station at the same time seen on the *base line*, by setting and moving the *perpendicular* as directed in the last case. This is also a case of right-angled triangles.

Thirdly.

Thirdly.—*To measure an inaccessible distance in an oblique angle, where a right angle cannot be obtained, by reason of some impediment on the ground.*

At the first station from which the distance is required place the instrument; then set up a staff in any attainable direction, to any distance at pleasure (the more distant the better). The instrument being set, with its *base* in direction to the staff, with one of the moving *limbs* take the angle of the object, and with the screw fix it thereto. This done, move the instrument in the direction of its base (being between the first station and staff set up) to any certain distance, (say 50 yards or measures,) as a second station. From this second station again take the angle of the object, and thereto fix the other moving limb; this done, the distance both from first and second station, as also the bases and perpendiculars, thereto will thus readily be seen. Set the *perpendicular* at random to any height, move the same till the upper point intersect the *upper limb*, or that most distant from the *base*, then read off on the *parallel*, the divisions parallel to the base subtended between the two *hypothenuses* or *limbs;* if this distance or division be equal to the distance measured on the base line (*i. e.* 50), then the distance of the object from both stations will be shewn on the two *limbs*, as will also the base and perpendicular on the respective lines. If the divisions on the *parallel* do not agree with the distance measured, the *perpendicular* must be altered till that division be shewn, when the required distance will be given. This is a case of our first problem.

Fourthly.—*To level or measure the altitude of any object.*

It is only necessary to set the plane of the instrument vertical instead of horizontal, by means of the joint under the instrument, whence it is evident every case may be known as on the horizon; and to level, it is only requisite to set the *spirit level* at the back of the instrument, the *base line* and every object cut by the same will be level thereto.

Fifthly.—*To take angles or altitudes at sea, where the instrument cannot be made stationary.*

For this purpose, it is first requisite to change the *sight a*, Fig. 1, and substitute the one *b*, Fig. 2; which being firmly fixed and adjusted at right angles with the upper limb, it is evident that when by reflection any object be brought to coincide on the *mirror*, at the extremity of the *base line*, with another object seen in the direction of such *base*, the angle will then be known, being double what the upper limb denotes on the *arch*, to which true angle, or its double, the *lower limb* may be fixed, leaving the one with the *mirror* again at liberty to take another observation and angle, at any distant place or time; which being so taken, this *limb* may be also moved and fixed to double its apparent angle, and the altitude or distance be then determined, by setting the *perpendicular* and *parallel* as in other common cases on land.

From this mode of determining distancces, as the use of calculations and of tables of sines and tangents are superseded, it is presumed that much convenience will arise to the unlettered who may have occasion to use it, and thereby the errors of calculations will be avoided.

As well as the before-mentioned purposes to which the instrument applies, it is presumed there will be found other

other things which it will perform, some it is hoped useful and some amusing; amongst which may be enumerated, Multiplication, Division, Rule of Three, Double Rule of Three, &c.; determining the area or sides of any sort of triangle from any proper data; determining the inscribing or inscribed circle of any triangle, square, or polygon, showing a mean proportional between two numbers, &c.

It is presumed, that an instrument, if perfectly made, on a large scale, would be found very useful and accurate in various practical calculations, as well for making them as for proving them after made in figures.

The following are specimens of the manner of calculating by this instrument.

First Question.—*If* 100 *l. in twelve months produce* 80*s. interest, what will* 100*l. produce in eighteen months; and also what will it produce in twelve months?*

On the *base line* of the instrument set 100*l.* On the *perpendicular* set 80, for shillings interest. Then bring the *lower limb* to intersect, which angle will then be, as *per* question, equal to twelve months at all places on the *base*; having so fixed the *lower limb*, move forward the *perpendicular* till it intersect the *lower limb* at the height 12 on the *perpendicular*, then raise the *perpendicular* to 18, and to the extremity thereof fix the *upper limb* to insersect, which angle will then be in proportion as 18 to 12 to the *lower limb*, being equal to the different times. The limbs being so fixed, it is only requisite to move the *perpendicular* to 200 on the *base*; and, raising the *perpendicular* till it intersect the upper limb, you will have thereon the answer 240 shillings, and at the same time, at the intersection on the lower limb 160, being the interest for twelve months only.

Second

Second Question. — *To determine the inscribed or inscribing circle of any polygon, the side being given; for example, the hexagon, whose side is* 100 *feet.*

Set one on the limbs to half the angle included in the required side of the hexagon, (*i. e.* 30 degrees,) then set the *perpendicular* to the height of half the side given, being as *per* question 50. Then move the *perpendicular* till the extremity intersect the *limb* before set, on which at such intersection will be denoted the radius of the inscribing circle, and at the same time may be seen on the *base* the radius of the inscribed circle.

Third Question. — *To find a mean proportional between* 600 *and* 200.

This depends on the well-known property of a right-angled triangle.

Set the *perpendicular* on the *base* line, at the distance of half of the difference of the two numbers (*i. e.* $\frac{600-200}{2}$); this done, raise the *perpendicular*, and move either of the *limbs* till the extremity of the *perpendicular* intersect thereon at half the sum of the numbers, being 400. This done, the height of the *perpendicular* will show the proportional required, being 347.

Note.—On the plate in which the perpendicular slides will be found Nonius's for subdividing the divisions on the base or perpendicular into ten divisions.

Reference to the Engraving of Mr. Salmon's Geometrical Quadrant and Staff, Plate X.

Fig. 1 represents the face of the quadrant, on which A is the fixed base line; B the moveable perpendicular; C the upper limb; D the lower limb; E the arc; F the nut,

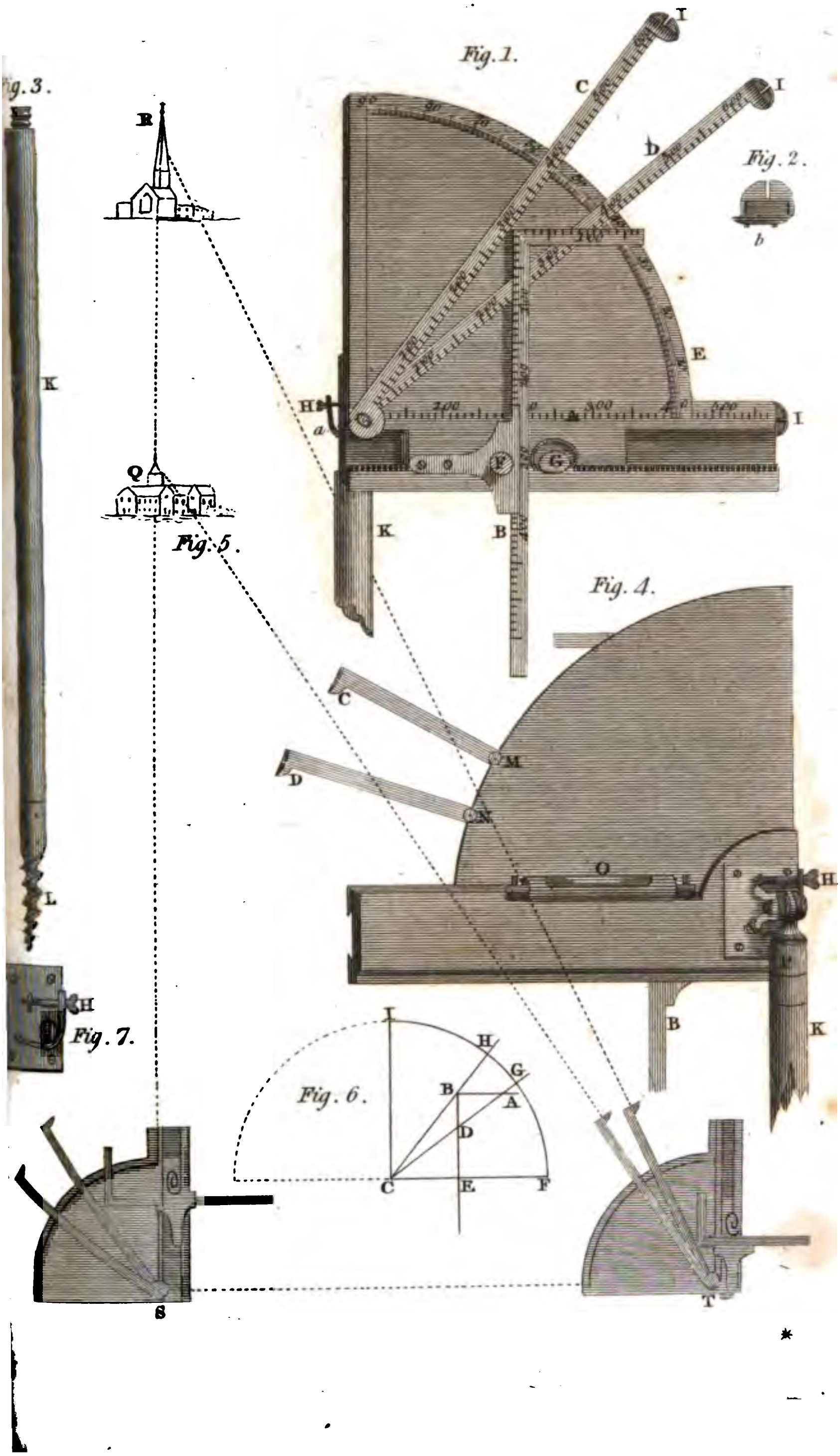


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.

nut, which moves the perpendicular by means of a rack and pinion; G a spring to keep the perpendicular steady; H a screw for fixing the joint of the staff; *a* the eye-piece, or sight, with a small hole in its centre; I I I the sights for direct vision, consisting of only a small slit in each. When objects are to be viewed by reflection, as with a Hadley's quadrant, the sight *a* at the centre is taken off, and the sight *b* with a mirror, shewn at Fig. 2, on rather a larger scale than the former, must be substituted.

Fig. 3, K is the staff, the mode of applying which to support the instrument when in use, is shewn by the same letters in the other figures; L is the screw by which the staff is fixed firm in the ground.

Fig. 4 represents the back of the quadrant; M N are the screws by which the upper and lower limbs are fastened after taking an observation; O a spirit-level; H the tightening screw for the joint before noticed; P the socket attached by its joint and tightening screw to the back of the quadrant; the staff K is screwed into the above socket.

Fig. 5 shews the practical method of using the instrument for determining the distances of the objects Q and R from the two stations S and T, at which the instrument is to be successively placed, and used as before described.

Fig. 6 is the diagram referred to at page 182.

Fig. 7 represents the mode of applying the tightening screw H, in Figs. 1 and 4, by means of the semicircular spring, inclosing the cylindrical stem or neck of the joint.

Chemical

Chemical Experiments on Guaiacum.

By Mr. WILLIAM BRANDE.

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

AMONG the numerous substances which are comprehended under the name of resins, there is perhaps no one which possesses so many curious properties as that now under consideration; and it is remarkable that no more attention has been paid to the subject, since many of the alterations which it undergoes when treated with different solvents, have been mentioned by various authors.

§ I.

Guaiacum has a green hue externally; is in some degree transparent; and breaks with a vitreous fracture.

When pulverised it is of a gray colour, but gradually becomes greenish on exposure to air.

It melts when heated, and diffuses at the same time a pungent aromatic odour.

It has when in powder a pleasant balsamic smell, but scarcely any taste, although when swallowed it excites a very powerful burning sensation in the throat.

Its specific gravity is 1.2289.

§ II.

1. When pulverised guaiacum is digested in a moderate heat with distilled water, an opaque solution is formed, which becomes clear on passing the whole through a filter.

The filtrated liquor is of a greenish-brown colour; it has a peculiar smell, and a sweetish taste.

It

It leaves on evaporation a brown substance, which is soluble in alcohol, nearly soluble in boiling water, and very little acted upon by sulphuric ether.

This solution was examined by the following re-agents.

Muriate of alumina occasioned a brown insoluble precipitate after some hours had elapsed.

Muriate of tin formed a brown flaky precipitate under the same circumstances.

Nitrate of silver gave a copious brown precipitate.

Suspecting the presence of lime in the solution, I added a few drops of oxalate of ammonia, when the liquid immediately became turbid, and deposited brown flakes, which, after having been treated with boiling alcohol, yielded traces of oxalate of lime.

These effects, therefore, indicate the presence of a substance in guaiacum, which possesses the properties of extract *; the action of the re-agent is however somewhat modified by a small quantity of lime, which is also in solution.

One hundred grains of guaiacum yielded about nine grains of this impure extractive matter.

2. Alcohol dissolves guaiacum with facility, leaving some extraneous matter, which generally amounts to about 5 *per cent.*

This solution is of a deep brown colour; the addition of water separates the resin, forming a milky fluid which passes the filter.

Acids produce the following changes:

A. Muriatic acid throws down an ash-coloured precipitate,

* By the term extract, I mean that substance which by chemists is called the Extractive Principle of Vegetables. Vide Thomson's Syst. of Chemistry, 2d edit. Vol. IV. p. 276.

pitate, which is not redissolved by heating the mixture. In this case the resin appears but little altered.

B. Liquid oxymuriatic acid, when poured into this solution, forms a precipitate of a very beautiful pale blue colour, which may be preserved unaltered.

C. Sulphuric acid, when not added in too large a quantity, separates the resin of a pale green colour.

D. Acetic acid does not form any precipitate. This acid is indeed capable of dissolving most of the resins.

E. Nitric acid diluted with one-fourth of its weight of water, causes no precipitate till after the period of some hours. The liquid at first assumes a green colour, and if water be added at this period, a green precipitate may be obtained; the green colour soon changes to blue, (when by the same means a blue precipitate may be obtained); it then becomes brown, and a brown precipitate spontaneously makes its appearance, the properties of which will be afterwards mentioned.

The changes of colour produced by nitric and oxymuriatic acids in the alcoholic solution are very remarkable, and I believe peculiar to guaiacum: there is, moreover, much reason to suppose that the above alterations in colour are occasioned by oxygen *. It likewise appears

* The following experiments appear to verify this supposition:

Fifty grains of freshly-pulverised guaiacum were introduced into a glass jar containing 60 cubic inches of oxymuriatic acid gas. The resin speedily assumed a brown colour, having passed through several shades of green and blue. Liquid ammonia was poured on this brown substance while yet immersed in the acid; the whole became green; it therefore seemed thus to be deprived of part of the oxygen which it apparently had acquired by the preceding experiment. An equal portion of the same guaiacum was exposed under similar circumstances to the action of oxymuriatic acid, excepting that the glass in which the experiment was made, was covered with a black varnish, and placed in

appears from that which has been stated, that the blue and green oxydes (if they may be so called by way of distinction) are soluble in the mixture of nitric acid and alcohol, while the brown precipitate is insoluble.

F. Alkalies do not form any precipitate when added to the solution of guaiacum in alcohol.

3. Guaiacum is less soluble in sulphuric ether than in alcohol; the properties of this solution nearly coincide with those just mentioned.

4. Muriatic acid dissolves a small portion of guaiacum, the solution assuming a deep brown colour; but if heat be applied, the resin melts into a blackish mass, preventing any farther action from taking place.

5. Sulphuric acid forms with guaiacum a deep red liquid, which, when fresh prepared, deposits a lilac-coloured precipitate on the addition of water; a precipitate is also formed by the alkalies. If heat be employed in forming this solution, the resin is speedily decomposed; and if the whole of the acid be evaporated, there remains a black coaly substance, together with some sulphate of lime.

6. Nitric acid appears to exert a more powerful action on guaiacum than on any of the resinous bodies.

100 grains of pure guaiacum, previously reduced to powder, were cautiously added to two ounces of nitric acid, of the specific gravity of 1.39. The resin at first assumed a dark green colour, a violent effervescence was

in a dark apartment. On examining the result of this experiment, the resin was found to have undergone precisely the same changes as when exposed to light. Ammonia had also the same effect.

Guaiacum was also exposed over mercury to oxygen gas; the resin assumed after some days the green colour which a longer exposure to the atmosphere produces: this change was likewise found by a second experiment to be effected without the presence of light.

 produced,

produced, attended with the emission of much nitrous gas, and the whole was dissolved without the assistance of heat, which is not the case with the resins in general, for when these bodies are thus treated with nitric acid, they are commonly converted into an orange-coloured porous mass.

The solution thus formed, yielded, while recent, a brown precipitate with the alkalies, which was redissolved on the application of heat, forming a deep brown liquid.

Muriatic acid also separated the guaiacum from this solution, not however without having undergone some change.

Sulphuric acid caused no precipitate.

After this solution of guaiacum in nitric acid had remained undisturbed for some hours, a considerable proportion of crystallized oxalic acid was deposited.

When guaiacum was treated with dilute nitric acid, the results were somewhat different. A slight effervescence took place, and part of the resin was dissolved, the remainder being converted into a brown substance, resembling the precipitate obtained from the alcoholic solution as above mentioned. (2. E.)

This brown substance appears to be guaiacum, the properties of which are materially altered by its combination with oxygen; and I am led to think that the changes of colour produced by nitric and oxymuriatic acids, are the consequence of the different proportions of oxygen with which the guaiacum has been united; for we know that the colours of metallic, and many other bodies, are greatly influenced by the same cause.

The brown substance was separated by filtration; the filtrated liquor yielded yellow flocculent precipitates with the alkalis, and ou examination was found to hold nitrate of lime in solution.

The

The undissolved portion was of a deep chocolate-brown colour. A similar substance may also be obtained by evaporating the recent nitric solution to dryness, taking care not to apply too much heat towards the end of the process.

The substance obtained by either of these means possesses the properties of a resin in greater perfection than guaiacum; it is equally soluble in alcohol and sulphuric ether, insoluble in water, &c. but when burned it emits a peculiar smell, more resembling animal than vegetable bodies. If, however, fresh portions of nitric acid be added three or four times successively, or if a large quantity be employed to form the solution, the product obtained by evaporation is then of a very different nature; for it has lost all the characteristic properties of a resin, having become equally soluble in water and alcohol; the solution of it in this state having an astringent bitter taste *.

7. Guaiacum is copiously soluble in the pure and carbonated alkalis, forming greenish-brown liquids.

Two ounces of a saturated solution of caustic potash took up rather more than 65 grains of the resin; the same quantity of liquid ammonia dissolved only 25 grains.

Nitric acid formed in these solutions a deep brown precipitate, the shades of which varied according to the quantity of acid which had been employed.

This precipitate was found on examination to possess the properties of that formed by nitric acid in the solution of guaiacum (2. E.) in alcohol.

* Vide Mr. Hatchett's two papers on an artificial substance which possesses the principal characteristic properties of tannin. Phil. Trans. 1805, pp. 211. 285; and inserted in the eighth volume of this work.

Dilute

Dilute sulphuric acid, when poured into any of the above alkaline solutions, formed a flesh-coloured curdy precipitate. Muriatic acid produced the same effect.

The two last-mentioned precipitates differ from guaiacum, in being less acted upon by sulphuric ether and more soluble in boiling water, their properties therefore approach nearer to extract. Moreover, when these precipitates were redissolved in ammonia, and were again separated by muriatic acid, the above-mentioned properties became more evident.

§ III.

100 grains of very pure guaiacum, in powder, were put into a glass retort, to which the usual apparatus was adapted. The distillation was gradually performed on an open fire, until the bottom of the retort became red hot.

The following products were obtained:

	Grains.
Acidulated water - - - - - - - - - - -	5.5
Thick brown oil, becoming turbid on cooling	24.5
Thin empyreumatic oil - - - - - - - -	30.0
Coal remaining in the retort - - - - -	30.5
Mixed gases, consisting chiefly of carbonic acid and carbonated hydrogen - - - -	9.0
	99.5

The coal, amounting to 30.5 grains, yielded on incineration 3 grains of lime. To discover whether any fixed alkali was present, 200 grains of the purest guaiacum (that in drops) were reduced to ashes; these were dissolved in muriatic acid, and precipitated by ammonia; the whole was then filtrated, and the clear liquor evaporated

rated to dryness, but not any trace of a neutral salt with a basis of fixed alkali was perceptible.

§ IV.

From the action of different solvents on guaiacum, it appears, that although this substance possesses many properties in common with resinous bodies, it nevertheless differs from them in the following particulars:

1. By affording a portion of vegetable extract.
2. By the curious alteration which it undergoes when subjected to the action of bodies, which readily communicate oxygen, such as nitric and oxymuriatic acids; and the rapidity with which it dissolves in the former.
3. By being converted into a more perfect resin; in which respect guaiacum bears some resemblance to the green resin which constitutes the colouring matter of the leaves of trees, &c. *
4. By yielding oxalic acid.
5. By the quantity of charcoal and lime which are obtained from it when subjected to destructive distillation.

§ V.

From the whole therefore of the above-mentioned properties, it evidently appears that guaiacum is a substance very different from those which are denominated resins, and that it is also different from all those which are enumerated amongst the balsams, gum resins, gums, and extracts: most probably it is a substance distinct in its nature from any of the above, in consequence of certain

* This substance was found by Proust to be insoluble in water, and soluble in alcohol. When treated with oxymuriatic acid, it assumed the colour of a withered leaf, acquiring the resinous properties in greater perfection. Vide Thomson's Syst. of Chemistry, 2d edit. vol. IV. p. 318.

peculiarities

peculiarities in the proportions and chemical combination of its constituent elementary principles; but as this opinion may be thought not sufficiently supported by the facts which have been adduced, we may for the present be allowed to regard guaiacum as composed of a resin modified by the vegetable extractive principle, and as such perhaps the definition of it by the term of an *Extracto-Resin* may be adopted without impropriety.

P. S. I have observed that the action of oxygen on some of the other resinous bodies is very remarkable. It is well known that by digesting mastich in alcohol a partial solution only is formed, and there remains an elastic substance, which is generally said to possess the properties of pure caoutchouc; it appears, however, to differ from this substance in becoming hard when dried by exposure to air. Moreover, I have remarked that the part of mastich which remains, dissolved by alcohol, may be again precipitated by water, and on examination I found the precipitate to possess the properties of a pure resin: but when a stream of oxymuriatic acid gas was made to pass through the solution, a tough elastic substance was thrown down, which became brittle when dried, and was soluble in boiling alcohol, but separated again as the solution cooled: its properties, therefore, somewhat approached to those of the original insoluble part.

On

On the Direction of the Radicle and Germen during the Vegetation of Seeds.

By THOMAS ANDREW KNIGHT, *Esq. F. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY.

IT can scarcely have escaped the notice of the most inattentive observer of vegetation, that in whatever position a seed is placed to germinate, its radicle invariably makes an effort to descend towards the centre of the earth, whilst the elongated germen takes a precisely opposite direction; and it has been proved by Du Hamel * that if a seed, during its germination, be frequently inverted, the points both of the radicle and germen will return to the first direction. Some naturalists have supposed these opposite effects to be produced by gravitation; and it is not difficult to conceive that the same agent, by operating on bodies so differently organized as the radicle and germen of plants are, may occasion the one to descend and the other to ascend.

The hypothesis of these naturalists does not, however, appear to have been much strengthened by any facts they were able to adduce in support of it, nor much weakened by the arguments of their opponents; and therefore, as the phænomena observable during the conversion of a seed into a plant are amongst the most interesting that occur in vegetation, I commenced the experiments, an account of which I have now the honour to lay before the Royal Society.

I conceived that if gravitation were the cause of the descent of the radicle, and of the ascent of the germen,

* *Physique des Arbres.*

it must act either by its immediate influence on the vegetable fibres and vessels during their formation, or on the motion and consequent distribution of the true sap afforded by the cotyledons; and as gravitation could produce these effects only whilst the seed remained at rest, and in the same position relative to the attraction of the earth, I imagined that its operation would become suspended by constant and rapid change of the position of the germinating seed, and that it might be counteracted by the agency of centrifugal force.

Having a strong rill of water passing through my garden, I constructed a small wheel similar to those used for grinding corn, adapting another wheel, of a different construction, and formed of very slender pieces of wood, to the same axis. Round the circumference of the latter, which was eleven inches in diameter, numerous seeds of the garden-bean, which had been soaked in water to produce their greatest degree of expansion, were bound, at short distances from each other. The radicles of these seeds were made to point in every direction, some towards the centre of the wheel, and others in the opposite direction; others as tangents to its curve, some pointing backwards, and others forwards, relative to its motion; and others pointing in opposite directions in lines parallel with the axis of the wheels. The whole was inclosed in a box, and secured by a lock, and a wire grate was placed to prevent the ingress of any body capable of impeding the motion of the wheels.

The water being then admitted, the wheels performed something more than 150 revolutions in a minute; and the position of the seeds relative to the earth was of course as often perfectly inverted within the same period of time; by which I conceive that the influence of gravitation must have been wholly suspended.

In

In a few days the seeds began to germinate, and as the truth of some of the opinions I had communicated to you, and of many others which I had long entertained, depended on the result of the experiment, I watched its progress with some anxiety, though not with much apprehension; and I had soon the pleasure to see that the radicles, in whatever direction they were protruded from the position of the seed, turned their points outwards from the circumference of the wheel, and in their subsequent growth receded nearly at right angles from its axis. The germens, on the contrary, took the opposite direction, and in a few days their points all met in the centre of the wheel. Three of these plants were suffered to remain on the wheel, and were secured to its spokes to prevent their being shaken off by its motion. The stems of these plants soon extended beyond the centre of the wheel: but the same cause, which first occasioned them to approach its axis, still operating, their points returned and met again at its centre.

The motion of the wheel being in this experiment vertical, the radicle and germen of every seed occupied, during a minute portion of time in each revolution, precisely the same position they would have assumed had the seeds vegetated at rest; and as gravitation and centrifugal force also acted in lines parallel with the vertical motion and surface of the wheel, I conceived that some slight objections might be urged against the conclusions I felt inclined to draw. I therefore added to the machinery I have described another wheel, which moved horizontally over the vertical wheels; and to this, by means of multiplying wheels of different powers, I was enabled to give many different degrees of velocity. Round the circumference of the horizontal wheel, whose diameter was also eleven inches, seeds of the bean were bound as in

 the

the experiment which I have already described, and it was then made to perform 250 revolutions in a minute. By the rapid motion of the water-wheel much water was thrown upwards on the horizontal wheel, part of which supplied the seeds upon it with moisture, and the remainder was dispersed, in a light and constant shower, over the seeds in the vertical wheel, and on others placed to vegetate at rest in different parts of the box.

Every seed on the horizontal wheel, though moving with great rapidity, necessarily retained the same position relative to the attraction of the earth; and therefore the operation of gravitation could not be suspended, though it might be counteracted, in a very considerable degree, by centrifugal force: and the difference I had anticipated between the effects of rapid vertical and horizontal motion soon became sufficiently obvious. The radicles pointed downwards about ten degrees below, and the germens as many degrees above, the horizontal line of the wheel's motion; centrifugal force having made both to deviate 80 degrees from the perpendicular direction each would have taken, had it vegetated at rest. Gradually diminishing the rapidity of the motion of the horizontal wheel, the radicles descended more perpendicularly, and the germens grew more upright; and when it did not perform more than 80 revolutions in a minute, the radicle pointed about 45 degrees below, and the germen as much above, the horizontal line, the one always receding from, and the other approaching to, the axis of the wheel.

I would not, however, be understood to assert that the velocity of 250, or of 80 horizontal revolutions in a minute will always give accurately the degrees of depression and elevation of the radicle and germen which I have mentioned; for the rapidity of the motion of my wheels

wheels was sometimes diminished by the collection of fibres of conferva against the wire grate, which obstructed in some degree the passage of the water: and the machinery, having been the workmanship of myself and my gardener, cannot be supposed to have moved with all the regularity it might have done, had it been made by a professional mechanic. But I conceive myself to have fully proved that the radicles of germinating seeds are made to descend, and their germens to ascend, by some external cause, and not by any power inherent in vegetable life: and I see little reason to doubt that gravitation is the principal, if not the only, agent employed in this case by nature. I shall therefore endeavour to point out the means by which I conceive the same agent may produce effects so diametrically opposite to each other.

The radicle of a germinating seed (as many naturalists have observed) is increased in length only by new parts successively added to its apex or point, and not at all by any general extension of parts already formed: and the new matter which is thus successively added, unquestionably descends in a fluid state from the cotyledons *. On this fluid, and on the vegetable fibres and vessels whilst soft and flexible, and whilst the matter which composes them is changing from a fluid to a solid state, gravitation, I conceive, would operate sufficiently to give an inclination downwards to the point of the radicle; and as the radicle has been proved to be obedient to centrifugal force, it can scarcely be contended that its direction would remain uninfluenced by gravitation.

I have stated that the radicle is increased in length only by parts successively added to its point: the ger-

* See Phil. Trans. of 1805.

men,

men, on the contrary, elongates by a general extension of its parts previously organized; and its vessels and fibres appear to extend themselves in proportion to the quantity of nutriment they receive. If the motion and consequent distribution of the true sap be influenced by gravitation, it follows, that when the germen at its first emission, or subsequently, deviates from a perpendicular direction, the sap must accumulate on its under-side: and I have found in a great variety of experiments on the seeds of the horse-chesnut, the bean, and other plants, when vegetating at rest, that the vessels and fibres on the under side of the germen invariably elongate much more rapidly than those on its upper side; and thence it follows that the point of the germen must always turn upwards. And it has been proved that a similar increase of growth takes place on the external side of the germen when the sap is impelled there by centrifugal force, as it is attracted by gravitation to its under side, when the seed germinates at rest.

This increased elongation of the fibres and vessels of the under side is not confined to the germens, nor even to the annual shoots of trees, but occurs and produces the most extensive effects in the subsequent growth of their trunks and branches. The immediate effect of gravitation is certainly to occasion the farther depression of every branch, which extends horizontally from the trunk of the tree; and when a young tree inclines to either side, to increase that inclination: but it at the same time attracts the sap to the under side, and thus occasions an increased longitudinal extension of the substance of the new wood on that side *. The depression of the lateral

* This effect does not appear to be produced in what are called weeping trees; the cause of which I have endeavoured to point out in a former Memoir. Phil. Trans. 1804.

branch

branch is thus prevented; and it is even enabled to raise itself above its natural level, when the branches above it are removed; and the young tree by the same means becomes more upright, in direct opposition to the immediate action of gravitation: nature, as usual, executing the most important operations by the most simple means.

I could adduce many more facts in support of the preceding deductions, but those I have stated I conceive to be sufficiently conclusive. It has, however, been objected by Du Hamel, (and the greatest deference is always due to his opinions,) that gravitation could have little influence on the direction of the germen, were it in the first instance protruded, or were it subsequently inverted, and made to point perpendicularly downwards. To enable myself to answer this objection, I made many experiments on seeds of the horse-chesnut, and of the bean, in the box I have already described; and as the seeds there were suspended out of the earth, I could regularly watch the progress of every effort made by the radicle and germen to change their positions. The extremity of the radicle of the bean, when made to point perpendicularly upwards, generally formed a considerable curvature within three or four hours, when the weather was warm. The germen was more sluggish; but it rarely or never failed to change its direction in the course of twenty-four hours; and all my efforts to make it grow downwards, by slightly changing its direction, were invariably abortive.

Another, and apparently a more weighty objection to the preceding hypothesis, (if applied to the subsequent growth and forms of trees,) arises from the facts, that few of their branches rise perpendicularly upwards, and that

that their roots always spread horizontally; but this objection, I think, may be readily answered.

The luxuriant shoots of trees, which abound in sap, in whatever direction they are first protruded, almost uniformly turn upwards, and endeavour to acquire a perpendicular direction; and to this their points will immediately return, if they are bent downwards during any period of their growth; their curvature upwards being occasioned by an increased extension of the fibres and vessels of their under sides, as in the elongated germens of seeds. The more feeble and slender shoots of the same trees will, on the contrary, grow in almost every direction, probably because their fibres, being more dry, and their vessels less amply supplied with sap, they are less affected by gravitation. Their points, however, generally shew an inclination to turn upwards; but the operation of light, in this case, has been proved by Bonnet * to be very considerable.

The radicle tapers rapidly, as it descends into the earth, and its lower part is much compressed by the greater solidity of the mould into which it penetrates. The true sap also continues to descend from the cotyledons and leaves, and occasions a continued increase of the growth of the upper parts of the radicle, and this growth is subsequently augmented by the effects of motion, when the germen has risen above the ground. The true sap is therefore necessarily obstructed in its descent; numerous lateral roots are generated, into which a portion of the descending sap enters. The substance of these roots, like that of the slender horizontal branches, is much less succulent than that of the radicle first emitted, and they are in consequence less obedient to gravitation;

* *Récherches sur l'Usage des Feuilles dans les Plantes.*

and

and therefore meeting less resistance from the superficial soil than from that beneath it, they extend horizontally in every direction, growing with most rapidity, and producing the greatest number of ramifications, wherever they find most warmth, and a soil best adapted to nourish the tree. As these horizontal or lateral roots surround the base of the tree on every side, the true sap descending down its bark, enters almost exclusively into them, and the first perpendicular root, having executed its office of securing moisture to the plant, whilst young, is thus deprived of proper nutriment, and ceasing almost wholly to grow, becomes of no importance to the tree. The tap root of the oak, about which so much has been written, will possibly be adduced as an exception; but having attentively examined at least 20,000 trees of this species, many of which had grown in some of the deepest and most favourable soils of England, and never having found a single tree possessing a tap-root, I must be allowed to doubt that one ever existed.

As trees possess the power to turn the upper surfaces of their leaves, and the points of their shoots to the light, and their tendrils in any direction to attach themselves to contiguous objects, it may be suspected that their lateral roots are by some means directed to any soil in their vicinity which is best calculated to nourish the plant to which they belong; and it is well known, that much the greater part of the roots of an aquatic plant, which has grown in a dry soil, on the margin of a lake or river, have been found to point to the water; whilst those of another species of tree, which thrives best in a dry soil, have been ascertained to take an opposite direction: but the result of some experiments I have made is not favourable to this hypothesis, and I am rather inclined to believe that the roots disperse themselves in every direc-

 tion,

tion, and only become most numerous where they find most employment, and a soil best adapted to the species of plant. My experiments have not, however, been sufficiently varied, or numerous, to decide this question, which I propose to make the subject of future investigation.

An Essay on the Cultivation of Potatoes.

By the Rev. EDMUND CARTWRIGHT.

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

POTATOES, though they have been naturalized to this climate for nearly two hundred years, were not considered as objects of field-culture till about half a century ago; and it is not much above half that time since they were first cultivated with any other view than as the food of man.

Their primary application ought certainly to be as an article of human sustenance, and yet, unless they can be produced on such terms as will enable the grower to afford them to his cattle and hogs, when there is no demand for them in the market, he will not venture to cultivate them, except perhaps for the London sale, on such a scale as will always insure a regular supply.

The original country of the potatoe is Brazil; and yet, though coming from between the tropics, it is the production of a temperate climate, being a native of the mountains, at such an altitude above the general surface of the country as not to suffer by too hot or too cold an exposure. Hence it accommodates itself to the vicissitudes of an English atmosphere with nearly the facility of an indigenous plant.

I. *The*

1. The Method of raising Potatoes from Seed.

In treating of this invaluable esculent, I shall begin with pointing out the method of raising it from seed.

It is to be observed, that the apple of the potatoe, which contains the seed, rarely, if ever, finds sufficient heat in this climate to ripen. The apples, therefore, are to be gathered with their stalks, and hung up in some warm place, a kitchen, for example, or other room where there is a constant fire. In the course of the winter the apples will become pulpy, which is an indication that their seeds are ripe. When in that state the seeds are to be separated from the pulpy part, either by washing or otherwise. When separated they are to be rubbed dry. Early in the spring they are to be sown on a warm dry border.

As it will be several weeks before the plants make their appearance, the best way it to sow the seed in pots or boxes, which in bad weather may be brought under cover, or sheltered.

The seed is sometimes sown in hot-beds, but I do not recommend the practice; for though the plants are by that method brought somewhat earlier to maturity, yet are they almost always weak and sickly. As soon as the plants are of sufficient strength, which will be about the latter end of May or the beginning of June, they should be transplanted where they are to remain. In doing this, care should be taken to select a warm situation, and where no potatoes have been grown in the former year, for fear of any roots or fragments of the last year's crop being left in the ground, and mixing with the new varieties, which it is the object of this process to obtain.

It is necessary to set the plants at such distances from each other as that their roots shall not interfere, which on

the first appearance of frost, if they are not ripe before, should be taken up.

It will be sufficient the first year to reserve only a single potatoe from each plant; for as the potatoe does not assume its permanent character at one year from the seed, no judgment can be formed of its future qualities in that stage.

The potatoes thus reserved, must next year be planted out at such distances as that their produce may be kept distinct.

Great attention should be paid to the time of their ripening, as the value of a potatoe is greatly enhanced, *ceteris paribus*, by its coming soon to maturity.

In the order in which they ripen, which is known by the deadness of the haulm, the potatoes should be taken up and examined. Such as have peculiarly good qualities to recommend them are, of course, to be preserved, and all of inferior quality should be made away with, that they may not get mixed with better sorts.

In the year 1804 I raised eighty-four plants from seedlings of the preceding year, all from the same kind of potatoe. The produce of scarcely any two roots were alike, either in form, colour, size, or taste. Some ripened early in August; others were not ripe even when the frost set in; some were very prolific, others but moderately so; some were so rank and offensive to the palate as scarcely to be eatable; and others again (but these were few in number, not more than three or four) were equal to the best potatoes now in use. One of them, indeed, was of so superior a quality that, unless it should degenerate on farther cultivation, it will eclipse almost every other species hitherto known.

In raising potatoes from seed, even though no new varieties were to be obtained, there will be found a great advantage

advantage in the practice, from the potatoes being more prolific than those which have been raised repeatedly through a long course of years from sets.

II. *Choice of Sorts.*

It has been recommended to those who intend raising potatoes for the purpose of feeding animals, to cultivate the sorts which are most prolific, without regard to their quality, such as the Howard, or cluster potatoe, the black yam, ox noble, &c. &c. a practice which cannot be too severely reprobated, both as injurious to the community, and as not being most beneficial to the growers themselves.

So long as there is a market for potatoes as an article of human food, they will always bear a better price than the grower can make of them, by giving them to animals. And even, when applied as the food of animals, the best sorts will always be found the most profitable, as containing the greatest quantity of nourishment in a given bulk.

It is universally allowed, that the most nutritious part of this excellent vegetable is the farinaceous or mealy part, and that the least nutritive, or rather the deleterious part, is the aqueous. Now I find by analysis, that a dry mealy potatoe, such as is usually considered of a good kind, yields of farina at least twenty-five *per cent.* more than such as are waxey or livery. The vegeto-animal matter also is more abundant in the one than in the other. But the latter kind is not only inferior, in as much as it contains less nutriment, but as it contains a superabundant share of that which is deleterious, namely, the watery part.

It seems almost needless to mention, that the juice of the raw potatoe is violently purgative, as is well known

known to every one who has given potatoes in large quantities to cattle or hogs, without a liberal allowance of dry food. Even when boiled, if they are suffered to remain in the water after its begins to cool, they will re-absorb so much of the juices they had parted with as to render them much too laxative, if given in large quantities, to be wholesome.

The first quality in a potatoe is being mild and farinaceous. Some indeed prefer the waxey sorts, but as they bear no proportion to those who have a contrary taste, it would never answer the grower's purpose to cultivate potatoes for such capricious customers. A potatoe, to be worth cultivating as an article of field husbandry, must be not only mild and farinaceous, but also prolific. Another property, which is seldom if ever adverted to, is, that it should not run much to haulm: for when the haulm is disposed to be over and above luxuriant, the potatoes admit not of being planted so close as to obtain the greatest possible crop in a given space, the distance at which they should be planted being determined by the luxuriance of the haulm, rather than by the productiveness of the root. Another quality, and that not an unimportant one, is, that they should ripen early. In this last circumstance there are greater advantages than at first sight may appear; namely, they may be taken up at the farmer's leisure; by coming to maturity at an early period, they are ready for the market before there is a glut; and, if they are to be stored, the days being long and warm, they get thoroughly dry before they are put up, and consequently are not so apt to heat and rot as when taken up later in the season, in rainy weather, as it may happen, or in frost. Add to these considerations, if wheat or winter-tares are to follow, there is sufficient time to get the ground ready for either of those crops. It

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may be expected, perhaps, that I should point out the particular sorts which I have found to have united in them the principal characters here enumerated. But any one the least conversant with the subject must know that to attempt a description, which could be intelligible beyond a limited district, would be nearly impossible, the names by which potatoes are usually distinguished being chiefly local. The sorts which have succeeded best with me were called, by those whom I had them from, the Supreme, a moderate-sized white potatoe; the early red; and the white American hundred eyes; names which they are probably known by only in the neighbourhood where they were originally raised.

The two former kinds have nothing discriminating in their form or external appearance to distinguish them from the common round white or red sorts. The American hundred eyes is readily distinguished from every other plant of its species that I have yet had an opportunity of observing. It is, in general, from four to six or seven inches long, cylindrical, slender, and, as its name imports, full of eyes. These are from twenty-five to thirty in number, and rather deeply indented. But the most striking peculiarity in this variety is, that the eyes do not break out, as in other sorts, apparently at random, but are regularly disposed in a spiral direction. It does not ripen quite so early as might be wished, but in other respects it has not at present its superior.

III. *The Soil proper for Potatoes, and its Preparation.*

Though potatoes will grow on any soil, they ought not to be cultivated on that which is cold, stiff, or wet. The best soil is a rich sand or a light loam. Very good crops, however, may be obtained even from poor soils, if dry and warm, and if well manured, and kept free from

weeds,

weeds, no crops making more ample returns for manure and good husbandry than potatoes.

It will be adviseable to give land intended for potatoes a ridge-ploughing before winter, provided it be not a light sand. In the month of February it should be again ploughed and harrowed down, and in that state should remain till the middle or latter end of March, by which time the seed weeds will begin to vegetate. A slight sprinkling of well-digested dung should be equally spread over the field, and ploughed in. But, perhaps, the best preparation for potatoes is a crop of turnips consumed on the ground: in that case nothing more is required than to give a single ploughing, followed by a liberal use of the harrows.

IV. *Manuring.*

It is a prevailing custom to manure for potatoes with long litter, old thatch, and even stubble, heath, or any other substance, in short, which will keep the ground hollow, under the idea that the young tubers of the potatoes have by such means more room to spread and expand themselves.

Where the soil is a stiff untractable clay it must be confessed that such manures are highly expedient; but on such soils potatoes ought not to be admitted, as both in quantity and quality they will always be inferior to such as are raised on a different soil.

The manures most proper for potatoes, when cultivated on land which suits them, are those which will mix and unite most readily with the soil. I know of no manures, I mean those of an animal or vegetable nature, nor, I might add, of the mineral kingdom, provided they are suitable to the soil, which come amiss to the potatoe.

The most advantageous way of applying manure to the potatoe crop is, to give part at the time of planting, and the

the remainder as a top dressing immediately before earthing up. Though when the land is in tolerable heart, so as to give sufficient vigour in the first stages of germination, and till the tubers begin to form, I trust solely to the top-dressing, which is applied with peculiar advantage to a potatoe crop, as it can be given at the precise point of time when most wanted, and immediate ploughed in; by which means it loses not a particle of its fertilizing quality by exposure to the exhaling influence of the atmosphere.

Many are of opinion, that the flavour of vegetables is influenced by the manures which are made use of in their cultivation. There is reason to doubt this opinion. In the year 1804 I had potatoes manured for with chandler's graves, with soot, and with malt-dust. Nothing can be imagined more offensive than chandler's graves when in a state of putridity, as they must be before they can be absorbed by the potatoe plants; nothing can well be more acrid and bitter than soot; nor can any thing be more mild and inoffensive to the palate than malt-dust, which is the germ of barley when sprouted for malting, and consists chiefly of mucilage, with a small proportion of sugar. Yet the potatoes produced with these three very discordant manures were all equally good, and in taste and flavour exactly similar. And yet, though manures may seem to have no influence on the sensible qualities of this vegetable, soil appears to have a great deal; for when cultivated on some descriptions of soil it loses, as it were, in every respect but its external form, its very identity. A potatoe, which in one soil is firm and dry, will in another be soft and watery, as though its very organization and texture had undergone a perfect change.

On what principle this is to be accounted for does not appear; nor is there any analogy, within the sphere of

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my observation, at least, that will furnish a solution of this difficult problem in vegetable economy. The general flavour of every kind of fruit or vegetable, if properly cultivated or not, will be the same on whatever soil it may be raised, varying only, and that perhaps but slightly, in the degree of its poignancy. No change of soil or culture can debase a nonpareil to a codlin, nor communicate to a codlin the flavour of a nonpareil, but under every change each will preserve its distinctive character.

V. *Method of Planting.*

A very common way of planting potatoes is to form the land into ridges from two to three feet wide, which are filled with manure, on which the sets are deposited, and then covered by a double-mould-board plough. Others plant them upon the level, after every third, and sometimes second turn of the plough. In both these ways there will be great irregularity. Besides, as the planters, who are generally women or children, have to exert their judgement as they go along, respecting the distances at which the sets are to be planted in the rows, they are a much greater time about the work than they would be, were they able to proceed without puzzling themselves to know when they were right, or when they were wrong.

The method I have practised, and which from experience I can recommend, is this: The land, being previously made fine by the plough and the harrow, is marked out into drills nine inches asunder. The implement I make use of for this purpose is what is called Duckett's drill-marker with five shares; an implement too well known to require a description. The drills being formed, an implement consisting of a pair of wheels, not quite twelve inches in diameter, fixed upon an axis at nine inches

inches apart, and having on their circumference a tooth or projection at every nine inches, and so placed as that the wheels shall mark alternately as drawn along the two drills, makes an indenture in each drill at every nine inches. It then misses one drill, and returns. When I do not use Duckett's marker, I have two marking wheels, which occasionally fit upon the axis of the implement above described, each of which is set at nine inches from the indenting wheels. Where the person who manages the implement returns to the right, the right hand wheel repeats its former track; when to the left, the left hand wheel. In general, however, I prefer marking out the land by Duckett's marker, the drills by that instrument being deeper and more defined than by the indenting implement alone.

The indentures being made, the planter then follows and drops in the sets, planting both drills as he goes along. In chusing the sets, large or good sized potatoes should be preferred, and only one eye left in each set.

The planting being finished, the field is run over with a bush or other light harrow, and then rolled. As soon as the young plants are three or four inches high, the ground is flat-hoed. When the plants are advanced in growth three or four inches more, the whole has a top-dressing of any manure which can be obtained suitable for the purpose, such as chandler's 'graves, soot, malt-dust, &c. &c.

The next operation is the earthing up, which immediately follows the top dressing. The implement I make use of is M'Dougal's expanding hoe, which I have drawn by that useful, but despised animal, an ass. And here I must observe, that for an operation of this kind both the ass and the mule are particularly adapted, not only because their feet are narrower than a horse's, even of

diminutive size, but because in their walk their feet follow each other in a line, so that they do not trample down the ridges, as horses are apt to do, as they go along.

As the plants stand alternately, the earth is thrown to the outside row, as well as to that which is nearest to the hoe; so that every plant gets earthed up on both sides. This operation being performed, which lays the land into twenty-seven inch ridges, having two rows of potatoes on each ridge, a careful person goes over the whole with a hand-hoe to rectify any little irregularity, and give the field a neat and uniform appearance. After this the plants have no more hoeings, as I hold it injurious, when the young tubers are formed, to disturb them. It is customary to give several horse-hoeings to potatoes in the course of the summer; and when the rows are planted at wide intervals, it frequently is necessary, were it for no other purpose than to keep down the annual weeds. But at the distance which I recommend them to be planted, the tops soon spread so as to occupy the whole ground, and smother what weeds might attempt to vegetate. If chance weeds appear amongst the plants, and over-top them, they are cut down with a knife. Were they to be pulled up by the roots, there would be danger of laying bare the young potatoes.

I am aware that it may be thought the plants are too crowded, by having two rows so near together, with so small an interval between them and the next two rows: and so indeed it would be, were it not that by setting the plants alternately, each row can be earthed up on both sides. By planting them uniformly, and, as I may say, with mathematical exactness, the greatest possible number of plants are set in a given space, without loss of ground, and, what is equally as necessary, without being crowded.

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In this mode of planting there will be something more than ten plants to a square yard, which is something less than a square foot for each plant.

Supposing the produce of each plant to weigh only twelve ounces, the produce of an acre will be above sixteen tons! But I have no doubt, if the potatoes are of a prolific kind, and well managed, they will produce at the distance I propose, at least one pound at each root in a favourable season. It may not, perhaps, be improper in this place to observe, that there is a circumstance in the cultivation of potatoes which, in the neighbourhood of rookeries, it is highly necessary to guard against, namely, the depredations of the rooks, both at the time of planting, and when they are approaching to maturity, as no crop is more frequently injured by these voracious plunderers.

TO BE CONCLUDED IN OUR NEXT.

Observations tending to shew the Action of pure Air upon Oils. By M. SENNEBIER.

From the ANNALES DE CHIMIE.

IN repeating the curious and important experiments of M. Berthollet, to investigate the influence of light upon oils that are exposed to its action, it appeared to me necessary to separate the action of light upon this fluid, from that which the air alone effects, in order to estimate, if possible, the influence of each of these substances on oil. I filled a glass recipient with distilled water; I passed into this recipient a certain quantity of olive oil, perfectly good; it rose to the upper part of the recipient, which I placed under water in a large saucer filled

filled with water; I exposed it in this state to the sun; I poured in the same manner a certain quantity of the same oil upon water in an open vessel, in such a way that this oily surface might be about a line in thickness.

This disposition was made the 26th of April 1790; on the 27th the olive oil exposed on the water had evidently changed colour, being already brown; then it whitened; afterwards it lost its fluidity, became very rancid, and resembled a very thick slimy matter: all these changes were produced during the first days of the month of May, and the oil apparently underwent no farther alteration during the rest of the year. The oil floated always on the water, which did not appear to me to suffer any sensible loss, for I always perceived that the oil remained at the same height in the glass.

The oil which had been placed under the recipient, where it had no communication with the air, did not appear to have suffered any alteration until about the middle of the month of May; it had preserved its colour and its fluidity, but at this time it formed a lining of green matter within the recipient, which even penetrated under the recipient itself. This green matter generated pure air, and from that time the oil lost its colour, and something of its fluidity, and became like the oil which had been exposed to the immediate action of the air.

It seems then, that light has no power to turn oil rancid when it has no communication with the air, since the oil resisted the action of the light for so long a time without being altered, while that which had been exposed to the air for the same length of time became almost immediately rancid.

But it is sufficient to take some mild olive oil, and to leave it exposed to the air, to be satisfied that it will become

come rancid, even in the dark, in a short time; while it will be seen to remain mild and good, when shut up by water in vessels that contain no air, and will spoil as soon as pure air is admitted to it; it must not, however, be concealed, that light encourages the union of pure air with oil, since it spoils much sooner when exposed to air and light than when exposed to air and darkness.

It is very difficult to give an exact description of the state of the oil which had been exposed upon water, both to the open air and the light, because this oil was filled with dust, and a number of insects, which had perished in it, so that it had neither its natural colour nor consistency; but we could easily judge of the state of the oil which had been enclosed in the recipient, where it had been first exposed, without injury, to the influence of light, and afterwards to pure air, without any mixture with foreign substances. In about four or five months this oil became white; it was slimy, and seemed more dense and more cohesive in the parts that adhered to the glass.

This whitening of the oil proved that the influence of pure air and light produce that effect. We know that the oxygenated muriatic acid bleaches wax as the light does, that it takes away the green colour from the Chinese wax and from that which is extracted from the birch and poplar trees.

It appears then that pure air, by combining with fat oils, developes the acid they contain, and that in thickening they gradually become the integrant parts of wood.

M. Chaptal has thought that pure air, mixed with the mucilage of oil, would turn it rancid, and that mixed with oil itself it would render it drying; but he did not confirm this opinion by experiment. It has appeared to me that olive oil exposed to the action of the air is entirely

tirely altered in its substance, and that it would be very difficult to distinguish two parts in the altered oil, the one mucilaginous and the other real oil; besides, pure air has an analogous influence on volatile oils, and perhaps it would reduce fat oils to the same state as volatile oils, if the first were not charged with a mucilage which is not to be found in the others. In short the fat oils become drying by being boiled with litharge, but in this case they take not only the oxygen from the oxyd of lead, but still undergo the boiling which frees them from their mucilage.

I have had occasion to remark that the fat oils which easily freeze, and particularly olive oil which is frozen when Reaumur's thermometer is 7 or 8 degrees above the freezing point, are not frozen when the thermometer has descended to 5 degrees below zero, after having sustained during the summer the action of air and light, thus approaching to the nature of drying oils, which are difficult to freeze; it is however curious that this combination of fat oils with pure air suspends the effects of the cold upon them in a remarkable manner.

With respect to the essential oils, I have kept them under water without being altered by the light, because, as it forms no green substance in the vessel, and there is no pure air introduced to combine with them, these oils preserve in this state both their proper smell and fluidity; the water in the recipient became only a little paler, but the oils did not thicken, neither did they change into resin, like those which were exposed to the free action of the air, or which were suffered to communicate with it by introducing it under the water.

It appears then that fat and essential oils may be kept free from all alteration by preventing the contact of air, by inclosing them in bottles filled intirely, and perfectly

corked

corked and reversed in vessels containing mercury sufficient to cover the neck of the bottle, about the breadth of a line or two above the place where the cork enters the bottle. These vessels should be kept in a place where the temperature is sufficiently equal to prevent the inconvenience arising from the dilation of the fluids, which might otherwise cause the vessels to burst; indeed I have not recommended water in the place of mercury though it produces the same effect, because it is necessary to be very careful to replace the water continually as it evaporates.

Method of obtaining the fixed Alkalies (Potash and Soda) crystallised, perfectly pure. By M. Lowitz.

From the Annales de Chimie.

1. THE caustic alkalies as they are obtained in the usual processes are pure enough for the purposes of medicine and the arts; but for chemical experiments the greatest purity is required in all the substances employed.

2. Until the present time the caustic alkalies have not been employed in the analysis of mineral substances. M. Klaproth made known their utility in analysis, not only for effecting easily the separation of alumine, but even to disintegrate the most refractory fossils. This induced me to describe more particularly the discovery which I made some years since on the crystallization of caustic alkalies, as a principal means of obtaining them perfectly pure. I am likewise desirous of seizing this opportunity to rectify the mistake of several chemists, who imagine that the crystallization cannot take place during the winter.

3. My first experiments on potash were made in the hottest

hottest days of summer, and the finest crystallization was formed even at the fire.

4. The crystallization of soda succeeded only in the winter, but the mean cold of about 5 degrees is sufficient for this efffect. The reason why this alkali requires this temperature must be, that its crystals dissolve with the slightest heat in the water of their crystallization. The same thing is observable of muriate of soda crystallized by cold *.

5. We were not yet enabled by the usual processes to obtain a caustic alkaline ley without colour; these leys were always more or less brown: by repeated crystallizations they could be made, even when most strongly saturated, as limpid as the purest water; which incontestibly proves that the usual leys are adulterated by heterogeneous substances, of which charcoal and the strongest calcination are incapable of depriving them.

6. The whole of the operation, for making caustic alkali perfectly pure and without the least colour, is as follows; a ley of caustic potash is evaporated until a strong pellicle is formed; after it has cooled, the foreign salt which is crystallized is separated from it, and the evaporation of the ley is continued in an iron vessel, such as is used for the preparation of common caustic. During the second evaporation the pellicle of foreign salts, and especially the carbonate of potash which continues to form, is carefully taken off with an iron skimmer. When no more skim is formed, and the substance has ceased to bubble, the fire is removed, and it is suffered to cool, being at the

* Lowitz has obtained this singular crystallization of muriate of soda, by exposing a solution of this salt to a great degree of cold. These crystals exhibited an hexagonal form two inches in diameter and the thickness of a line; they dissolved into a liquid at a temperature some degrees below zero, and formed into a very fine and very white powder at a very cold temperature. V. M.

same

same time continually stirred with an iron spatula. It is afterwards dissolved in double its weight of cold water; the solution is filtered and evaporated in a glass retort, until it begins to deposit regular crystals: if it happen that the mass consolidates ever so little in cooling, a little water is added to it, and it is heated afresh to render it fluid. When a sufficient quantity of regular crystals are formed, the liquor, which is very brown, is decanted; the salt is left to drain, and is redissolved in the same quantity of water. The liquor thus decanted is preserved in a bottle well corked, and is left for some days to deposit. When this is clear it is again decanted, (leaving the deposit in the bottle) that it may be evaporated and crystallized again, which operation is repeated as long as the crystals which form it yield (with the least quantity of water possible) dissolutions perfectly limpid. These solutions are preserved in bottles well corked, to secure them from the air.

7. The greatest impediment in this process is, that the ley imbibes with great facility a saline mass not crystallized. To obviate this inconvenience, a small portion of the ley is concentrated, until it is converted into a solid mass by the cold; the saturation of a ley properly evaporated, is proved, by throwing into it as it cools small pieces of this mass; when these pieces no longer dissolve, it is a proof that the ley is sufficiently saturated. I have formerly shewn, in an article on the crystallization of salts, the principles on which this practice is founded*.

8. This method of proceeding is absolutely indispensable in the crystallization of soda, which may be likewise effected in the same manner as that of potash; if this method be not employed, this alkali never fails to form into a solid mass as it cools.

* Annales de Chimie, vol. XXII.

9. As for the foreign salts which are contained in the potash, the greatest part are separated from it by the crystallization which follows the first evaporation of the ley; the remainder separates during the second concentration of the ley, owing to the continual removal of the skim; the little which may afterwards be found to remain with the potash ought to precipitate, without the dissolving water, in a ley where the alkali itself is only dissolved by its water of crystallization.

10. That property of caustic alkalies, of dissolving in highly-rectified alcohol, with the exclusion of all foreign salt, would furnish an excellent method of obtaining this salt very pure, if its effect on the alcohol would not expose the alkali to some other impurity; for, when one of these salts which is perfectly pure and crystallised, is dissolved in spirits of wine, even cold, it takes a very deep brown, which becomes still deeper when it is decanted off above the saline mass.

11. The crystallization of potash succeeds in different ways, according as the crystals are formed, whether by cold or by heat. In the first case it produces octaedral crystals in clusters which contain 0.43 of water of crystallisation, and which occasion by their dissolution in the water, even in summer, a coldness very nearly approaching to freezing. In the second case it forms crystalline leaves, transparent, very thin and remarkably large, which, by an assemblage of angles and directions which form numberless intersections, produce a sort of cells or cavities, which are mostly so closely joined that the glass may be reversed without losing a drop of the water of crystallization, which is sometimes enclosed to the quantity of one or two ounces. On this account it is necessary to break this beautiful crystallization each time, in order to favour the escape of the ley. The crystals produce

duce in their formation regular tetragonal rectangular leaves, which, as they contain a little of the water of crystallization, produce, in union with the octaedral crystals, a considerable degree of heat when dissolving in water.

12. By melting unto incandescence similar alkaline crystals in a proper crucible, and by pouring out the substances in certain forms, a caustic stone is obtained, which is as white as snow, and extremely caustic and deliquescent.

13. As, during the time necessary for the salt to drain, the crystals and the ley often become charged with a portion of carbonic acid, it is best, in order to avoid this inconvenience as far as possible, to pour the ley, when sufficiently saturated, into a narrow-necked bottle, and to cork it well, that the salt may crystallize; when the crystals are formed, the bottle is reversed unopened, and kept at a temperature moderately warm, until the crystals are perfectly dried. In the winter, the liquor after the first crystallization continues to crystallize without requiring a second evaporation, provided it be exposed to a temperature rather colder than that in which the first crystals were formed *.

* Crystals may be likewise obtained from caustic potash, by evaporating successively a solution of the potash of commerce, until a slight pellicle appears. The first crystals that form are alkaline carbonate, and the last are pure potash. Thus a similar ley is reduced into very regular crystals, to the last portions of salt that it contains; half an ounce of the residue of a solution of several pounds likewise produces besides very regularly formed crystals. It is observable that the last crystallizations form with infinitely greater facility than the first. I made this observation in a memoir on the preparation of carbonate of potash for the mephitic alkaline water of *Colbourn*, which I addressed in the beginning of 1793 to the *Société Philomatique de Paris*, and which has been partly printed in *l'Esprit de Journeaux* of the same year. V. M.

Report

Report on the different Methods of extracting with Advantage the Salt of Soda from Sea-Salt.

By LELIEVRE, PELLETIER, D'ARCET *and* GIROUD; *extracted by* J. C. DELAMETHERIE.

From the JOURNAL DE PHYSIQUE.

THE great consumption of soda or natron in different arts of the first importance, such as glass and soap-making, &c. the difficulty of procuring this soda in the Northern countries, which they are obliged to import at a great expense from the coasts of Spain and the Levant, has induced enlightened chemists to decompose sea-salt in order to extract this soda. I saw, in 1788, several of those undertaken in England, and I gave an account of them in the Journal de Physique for January 1789, p. 43. I there said, "there is a method of accomplishing this decomposition, which would be very certain, but may perhaps be too expensive. It consists in pouring (into proper apparatus) vitriolic acid upon sea-salt; the muriatic acid will then be disengaged, and pass into the balloons, and the residue will be composed of vitriol of natron, or Glauber's salt. This vitriol of natron may be afterwards decomposed by calcining it with charcoal: the muriatic acid will be pure, and sal ammoniac may be made from it, by extracting the volatile alkali either by charcoal, which is Lord Dundonald's method, or by the combustion of animal substances, which is M. Beaumé's."

M. Leblanc, a very well-informed chemist, came to confer with me on that subject: he experimented on it, and employed the following process, in the large way, in a manufactory which he had established with M. Dizé, at St. Denis, near Paris.

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This process consists in decomposing sea-salt or muriate of soda by the help of sulphuric acid. This first operation yields a sulphate of soda or Glauber's salt; it is this Glauber's salt which afterwards, in its turn, must be decomposed by driving away the sulphuric acid, so that the base of sea-salt or soda remains free. This is what is obtained by means of washed chalk and charcoal. The chalk is brought from Mendon, which is near the manufactory.

The decomposition of sea-salt is effected in two furnaces placed beside each other, and which are employed successively, to facilitate the continuance of the work.

These are reverberating furnaces, the floor is horizontal; it is covered with a plate of lead, the edges of which are raised four inches, sustained entirely by the brick-work, and guarded on the side next the fire-place by an elevation of six inches. The chimney is at the opposite extremity: on the sides are two openings, in order to introduce the muriate of soda, to stir the fuel conveniently when circumstances require it, and by which to withdraw the fire when the preparation is terminated. The third opening is at the side of the chimney, and opposite to the fire-place: it is by this opening that the sulphuric acid is introduced by means of a leaden funnel, having a long tube, and which is supported by two strong iron hooks.

The sea-salt should be reduced to a very fine powder; and this is usually effected by a windmill. When all is ready to begin, the fire is lighted; and the heat and the current of air from the fire-place passing into the interior of the furnace, the leaden case will be heated on the upper side. It has been found, that this method preserves the metal from melting, which otherwise never resisted four successive operations, when the heat at the commencement

mencement had been applied to the under-side of the plate. When the lead is too warm for the hand to bear, it is charged with 200 pounds of sea-salt, which is equally spread over it: 276 pounds of sulphuric acid are added to it, at 45 degrees of heat. The fuel is stirred at the openings, with a bar of wood, three times at least during the operation. That being done, the openings are closed, and carefully luted. At last, when the moisture is nearly dissipated, and the substance begins to harden, the fire is increased; it is continued until it is quite hard, then the fire is suffered to decrease, and the substance is taken away in pieces.

The two furnaces appear externally to have one common chimney; nevertheless they are placed back to back, and are separated by a partition.

They are so constructed, that the muriatic acid may be suffered to escape, or may be retained, at will, by the assistance of a chamber of lead placed against the chimnies, and which serves to interrupt, or leave free, the communication with the interior of the two furnaces. When the acid is to be retained, the passage is intercepted, and then the vapours and the acid gas are detained in the chamber of lead by the current of heat and the air from the furnace. In the opposite case, the passage is left free, and the passage to the chamber is closed.

There are two objects for which the muriatic acid is retained: one is for the use of bleachers and others who have occasion for it, and the other is for making sal-ammoniac. This combination is effected in the same chamber of lead in a very simple way. During the vitriolisation of the sea-salt, and while the muriatic gas is detained in the chamber, a current of volatile alkali enters at the same time, which is composed by the help of the

the animal substances which are burnt in three cylinders of iron, disposed in a furnace placed on the side: the vapours and muriatic acid gas are then condensed in the chamber of lead, not only by their combination with the volatile alkali, but likewise by the help of an eolipyle conveniently disposed, and which is heated by the same furnace. The sal ammoniac is thus formed in a state of vapour, and in proportion as it disengages the principles of this new combination. These two furnaces may be made to operate twice in each day, and even four times, if the work be continued during the night.

The decomposition of muriate of soda is not entirely effected in this first operation; the case of lead does not retain a strong heat: it is therefore put into a third reverberating furnace, paved with bricks, where the heat is strong enough to fuse it.

When the muriate of soda is thus vitriolised, it is ground in a mill, where it is bruised by the weight of a cast iron cylinder, charged with lead, and which is turned by a horse. This operation mixes the substances in the following proportions: sulphate of soda 1000 pounds, chalk of Meudon, washed, 1000, of charcoal 550.

The chalk is not put in the mill until after the sulphate and the charcoal are well mixed.

The mixture of the substances being finished, it is put into a reverberating furnace of the same construction as the preceding one, and which should likewise be paved with bricks well burnt and carefully laid.

It is in this furnace that the decomposition of sulphate of soda is effected, and that the soda is set free. Here attention and vigilance become necessary: the different phenomena must be carefully noticed as they occur, because on them depends the regulation of the fire and the term of the operation.

The furnace should be red-hot before it is filled with the materials: this is performed by a workman with a shovel; the charge is 400 pounds.

As soon as the furnace is shut again, the fire is immediately attended to, lest the torrent of flame should carry off much of the mixture, which is yet in powder; but as soon as the furnace is shut, the substance begins to work. It melts, and forms by degrees into balls. This is the time when it should be stirred with an iron rake, in order to bring to the top the substance which lies underneath where the fire cannot penetrate.

It is no sooner reduced to the state of a uniform melted mass, than a sulphuretted hydrogen gas escapes from the whole mass of salts, which separates from the body of paste with a sort of explosion which is very sensible, comes to the surface, is immediately inflamed by the current of air, and thus exhibits the appearance of an artificial firework.

This agreeable phenomenon is accompanied by effervercence and bubbling; this is the time to stir it briskly, in order to consume the sulphur which forms, and to hasten the disengagement of this hydrogen gas, which is the effect of its decomposition. For this reason the workman should not cease stirring it, except when the bubbling ceases and the jets of flame no longer spout out; then the mass becomes more fluid. If a bar of iron be dipped into it, and if the crust which covers it, and which breaks as it cools, discovers a close grain, it is judged that the operation is nearly finished, and that it is time to take it out or remove it from the furnace, for if it were left in any longer, the alkali would lose a part of the carbonic gas, which it has received from the chalk.

It is equally necessary to watch the fire, during this last period of the operation; too much heat would infallibly

cause

cause the chalk to fry by the alkali, as too little fire would suffer the substance to harden, so that it would be almost impossible to take it out of the furnace; but an intelligent and clever workman will prevent these inconveniences, and in this case custom and habit instruct sooner than precepts or particular directions. The substance is drawn out of the furnace with an iron rake; it falls to the ground in the form of a soft paste, earthy, and on fire; it hardens as it cools, then it breaks easily and exactly resembles the rough soda of commerce or barilla, which it was their object to imitate. 1562 pounds of this substance yields from the furnace 900 pounds of unrefined soda.

As the paste cools it is broken into blocks of different sizes; it is carried to a lower warehouse which should be damp; there it falls into powder, by the help of the damp atmosphere and the oxygen which forms the carbonic acid, which it absorbs, and with which it is saturated.

It must not be sold too fresh, because the alkali and the chalk having become a little caustic, remain still combined with a portion of sulphuretted hydrogen gas, perhaps also with a little sulphur, and they still hold a good deal of charcoal in solution; and a ley made with this fresh soda would be sure to stain linen. There would be the same inconvenience in the soda of commerce, if it were to be used when newly prepared.

But when it has been once exposed to the air, and is a little old, the carbonic acid with which it is saturated, entirely abandons it, and the charcoal and calcareous earth which it held in solution. As for the rest, the blueish stain which this fresh soda deposits on linen, disappears in the drying, and is no farther an inconvenience than as it alarms those who have not tried it.

Hh 2 They

They afterwards sought to purify this soda by the following processes:

1. It was dissolved in water to separate the earth and the charcoal. The operation is performed cold in the casks, and in the same way as they wash old dry plaster for saltpetre. This ley concentrates by evaporation; and thus the carbonate of soda or crystallized soda is obtained. The produce of the crystals is sixty-five pounds from the quintal.

2. The mother-waters which remain, and which are a long time crystallizing, or they crystallize badly, are evaporated to dryness. This salt, which is still mixed with charcoal, which the caustic soda holds in solution, is put into a furnace to be calcined; and by the help of a mild heat, and a proper degree of agitation, the soda is freed from this substance, and comes out as white as potash, after undergoing these two operations.

The soda, according as it is taken in one of these three states, may be employed for three different purposes. In its rough state it will serve to make leys, soap, &c. like the common barilla.

The crystallized soda may be employed in pharmacy and in chemical elaboratories for essaying crystal, for dying, &c.; and, lastly, soda evaporated to dryness, and calcined, will be found ready prepared for making white glass, &c. These were the three principal objects which the proprietors of this new manufactory had in view in the plan of their undertaking.

The two last operations on the soda, that is, its crystallization and its calcination, are much more easily performed, and more largely in this apparatus, than in private manufactories, where apparatuses must be set up expressly for that purpose.

After

After having stated the process and the manner in which the work is carried on at St. Denis, we judged it necessary to bring away samples of its products, in order to analyse them ourselves, and thus to be assured of their results.

Our first experiments were made upon five pounds of these samples: they were coarsely pounded; the ley was made first with cold and afterwards with warm water; the latter exhaled a slightly hepatic smell. It was evaporated and set to crystallize, and a carbonate of soda was obtained, weighing one pound fourteen ounces. The mother-water was evaporated to dryness, and yielded a mass of soda, partly caustic, partly aerated, and weighing fifteen ounces five drachms; two ounces seven drachms of muriate of soda were separated from it. The earthy residue which remained was a sulphuretted chalk, from which sulphur might be extracted, and which weighed three pounds ten ounces six drachms.

These experiments, made with care, have produced from a quintal of rough soda,

	lb.	oz.
Soda crystallized - - - - - - - - -	37	8
Soda evaporated to dryness - - - -	23	2
Residue of the lixivation - - - -	73	7
Total weight of the products - -	134	0

The augmentation of weight that is observable in these products must be attributed to the water which they retain.

The earthy residue or sulphuretted chalk contains in the quintal,

Charcoal

	lb.	oz.
Charcoal - - - - - - - - -	1	8
Sulphur - - - - - - - - -	12	0
Chalk - - - - - - - - - -	86	0

At the same time 250 pounds of the same rough soda was made into a ley. It yielded 100 pounds of soda, dry and pulverulent, of a reddish-grey colour, and still containing water, nearly in the same proportion as the salt of potash, as it comes from the boilers, and before it has passed through the calcining furnace.

The analysis of this 100 pounds of soda yielded,

	lb.	oz.
Soda dried to a salt, and the greater part caustic - - - - - - - - - - -	72	8
Muriate of soda - - - - - - - - - -	10	0
Sulphuret of lime, charcoal, and iron -	7	13
Water - - - - - - - - - - - - - -	9	11
Total - - - - - - - - -	60	0

Process of M. Alban, *Director of the Manufactory at Javelle.*

This is the second process that we have followed and examined in the large way. M. Alban, director of the manufactory established at Javelle, near Paris, succeeded in extracting soda from sea-salt by another process. As his manufactory furnished a great quantity of muriatic acid to different bleaching manufactories, he had a quantity of sulphate of soda remaining from this preparation, and it is from this sulphate that he extracts soda by the agency of iron.

On the 28th Germinal we assisted at an experiment made at his manufactory.

The

The weight of the materials were:

	lb.
Sulphate of soda, calcined - - - - - -	200
Pulverized charcoal - - - - - - - - -	40
Clippings of tinned iron, iron plates, &c.	65
Charcoal cinders - - - - - - - - - -	22
Total - - - - - - -	327

A reverberating furnace was first filled, which had been carefully heated some hours before, with a mixture of sulphate and forty pounds of charcoal in powder: the furnace was shut. An hour afterwards the substance was stirred, and when the mixture was well melted, forty pounds of iron clippings and of old iron plates were added to it, for iron of any sort will serve for this purpose. The clippings of tinned iron plates were preferred in this case, because, being very thin, and consequently presenting more surface, this metal is in this state sooner attacked and dissolved. The whole was stirred together occasionally, and in the interval they were very careful in keeping the door of the furnace shut. The matter, which was at first melted and liquid, afterwards became more consistent; it bubbled, swelled, and frothed. The iron was soon dissolved; then sixteen pounds of charcoal-cinders were added to it; they were stirred together, and there soon appeared on the surface the same jets of sulphuretted hydrogen gas, as in the experiment made at St. Denis. When all the iron appeared to be entirely dissolved, the other twenty-five pounds of iron clippings and six pounds of charcoal-cinders were added; they were frequently and carefully stirred, and the mixture continued to furnish abundantly the jets of flaming sulphuretted hydrogen gas.

At

At last the substance being in a state of perfect fusion, and the jets of flame becoming less frequent, the mixture is withdrawn from the fire, by causing it to run to the ground between plates of iron, so disposed that the workmen may not be burnt by the splashes from this mass of melted and inflamed matter.

This rough soda, when cool, was of a blackish brown, it was soon covered by a yellow efflorescence; the contact of the air made it still blacker, its taste was caustic; it exhibited when broken an even surface, striated, brilliant, and metallic; it loosens quickly in the air, with the disengagement of caloric. Its weight when it came out of the furnace was 215 pounds. The loss therefore was 134 pounds. The whole of the operation lasted for the space of three hours.

TO BE CONCLUDED IN OUR NEXT.

List of Patents for Inventions, &c.

(Continued from Page 160.)

WALTER HENRY WYATT, of Hatton-Garden, London, Gentleman; for the means of facilitating the chemical action between copper and several saline substances, so as to produce important improvements in the art of separating gold and silver from copper, plated or united with either of those metals, and in the manufacturing of sulphate of copper, and in the making of many kinds of colours for painting. Communicated by a foreigner. Dated January 15, 1807.

CHESTER GOULD, of Birmingham, in the county of Warwick, Gentleman; for a machine to ascertain the weight of any thing to the amount of ten tons and upwards, to be made use of instead of the common steelyard, or beams and weight. Dated January 24, 1807.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LVIII. SECOND SERIES. March 1807.

Specification of the Patent granted to CHARLES SCHMALCALDER, *of Little Newport Street, in the Parish of Saint Ann's, Soho, in the County of Middlesex, Mathematical and Optical Instrument Maker; for a Delineator, Copier, or Proportionometer, for the Use of taking, or tracing and cutting out, Profiles; and for copying and tracing reversely upon Copper, Brass, hard Wood, Card Paper, Asses Skin, Ivory, and Glass, in any required Proportions, directly from Nature, Land- scapes, Prospects, or any Objects standing, or previously placed perpendicularly; as also Pictures, Drawings, Prints, Plans, Caricatures, and public Characters.*

Dated December 22, 1806.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that I the said Charles Schmalcalder, in compliance with the said proviso, do hereby describe and ascertain the nature of my invention, and the manner in which the said invention is to be constructed, applied, and worked, is in manner and form hereinafter described,

with reference to the figure, plate, or plan, thereof, hereunto annexed; that is to say: My invention consists in constructing, applying, and working, the following machine; which, for the sake of distinction, I call a delineator, copier, proportionometer, consisting of a hollow rod, *a*, Fig. 1 and 2, (Plate XI.) (the latter forming a section of the instrument) screwed together, and from two to twelve feet, or still longer, chiefly made of copper and brass, sometimes wood, or any metal applicable. The one end, *b*, carries a fine steel tracer, *c*, made to slide out and in, and to be fastened by the milled head, screwed; the other end of the rod having likewise a round hole, to take up either a steel point, black-lead pencil, or any other metallic point; which may be fastened therein by a milled head screw, like *d*. I fix a tube in a ball, *e*, about ten inches long, and in diameter sufficiently to allow the rod, *a*, to slide easily, and without shake in it. The ball with this tube is moveable between two half sockets, forming together what is commonly called a ball and socket. *ff* is a frame made of wood, and about two and a half or three feet long (this length depending from the length of the rod), and is supported by two brackets. Through the sides of the frame *ff* are holes at certain distances, corresponding with the marks on the rod *a*; hence it is evident that in copying any original, supposing to the size of one-eighth, one-fourth, one-half, three-fourths, &c. the swing-board, *g*, and the clamp screw, *h*, must be transplanted to the different holes and divisions corresponding. The paper, ivory, or copper, &c. is fastened upon the swinging-board, either by screws or by a brass frame formed of two flat pieces of brass joined together at the end by hinges, and having on the other end two buttons to fasten the paper between. In the uppermost of this plate an opening is made to allow the point

Fig. 1.

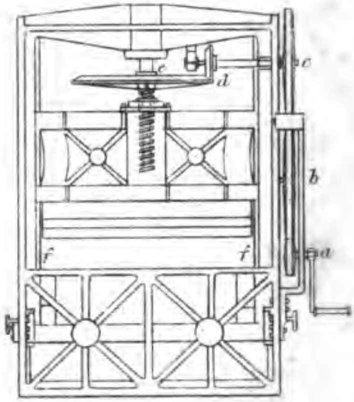


Fig. 2.

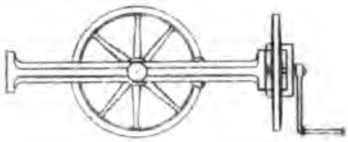
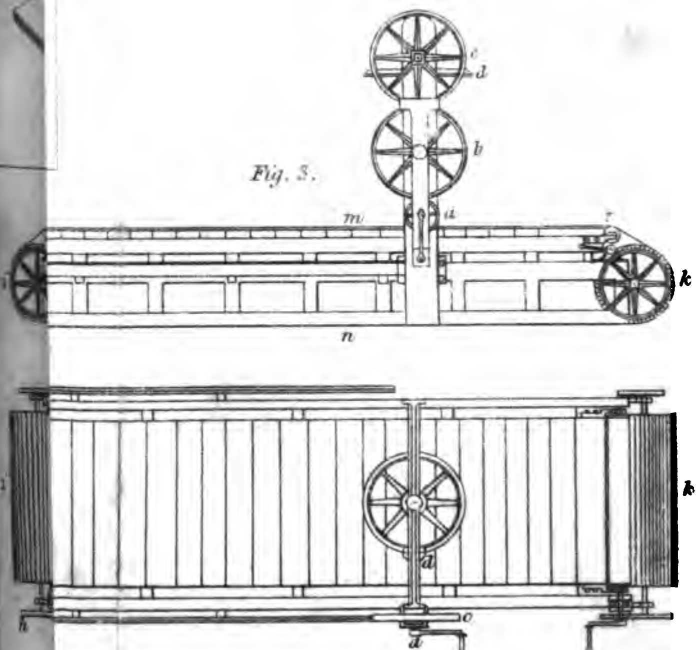


Fig. 3.



point to mark upon the paper. The edges of this frame form and slide in a dovetail moveable upon the swinging-board, and kept in the proper situation by the spring, *i*. On the back of the board is affixed a weight with a hook, *k*; to which is attached a spring, forming a pulley, serving to prevent the point from acting upon the paper when not wanted.

The machine is fixed either to a partition in any room, or to any piece of wood portable and so constructed as to be easily fixed upright with a screw clamp, upon a table, or any other stand. The instrument is perfect, 1st, when all the parts are firmly connected, and without fluctuation; 2dly, when the ball and sockets are truly circular, and move easy; 3dly, when the rod passes truly through the centre of the ball; 4thly, when the rod is perfectly straight (the diameter of the rod is from half an inch to two inches and upwards, according to the length); 5thly and lastly, in turning the rod round in the the sockets the tracer and point in the two ends of rod must remain in the centre. To obtain which, sometimes an adjustment with four screws, Fig. 3, is required. *a*, Fig. 3, is a steel point; *b* the tracer, and *c* the form of the cutters used for cutting-out the profiles; *d* is a hook hanging on a string, for the rod to rest in. Having thus far mentioned and described the construction of this my new invention, so as, to the best of my belief and knowledge, will enable any person or persons to work and make an instrument accordingly, I proceed to describe the use of the delineator. 1st, for taking profiles, previous to the fixing of the instrument against the partition, you must have taken the height from the bottom to the middle of the face of a person sitting upon a chair; and, that height transferred upon the partition in the place where the sockets are to be fastened, let the person's head rest

against a piece of wood lined with leather. Begin tracing at the back; and in tracing observe, the screw to form a right angle with every part of the face in passing over it; in consequence whereof you must turn the rod round in the socket, and the cutter, *c*, previously fixed in the rod, will cut out the profiles. 2dly, when I copy and trace pictures, landscapes, &c. I hang the original up so as to swing, and fix either paper, ivory, copper, &c. upon the swinging board; then, placing the tracer to the edge of the original picture, then begin following and tracing over every part of the picture; by which means I receive a copy upon the copper, ivory, &c. reversely from the construction of the instrument. It is evident that the original as well as the ivory, &c. must swing, on account of the tracer in the rod describing a circle from the centre of the ball. Supposing, however, a picture of the size of eight feet square is to be copied upon copper to half the original size, by a rod of about ten feet, or even eight feet long, the circle described by the rod or tracer from the centre of the ball would not deviate above one foot from the plane surface of the picture. Hence this would be the space the original would swing during the operation, and the swinging-board in proportion. 3dly and lastly, when I copy from nature landscapes, or whatever object exposes itself to view, the machine remains as during the operation above, and looking along the rod keeping the tracer and the perpendicular object together in sight, I follow and trace the latter, and receive a copy as above.

In witness whereof, &c.

Specification

Pl. XI. Vol. X. Second Series.

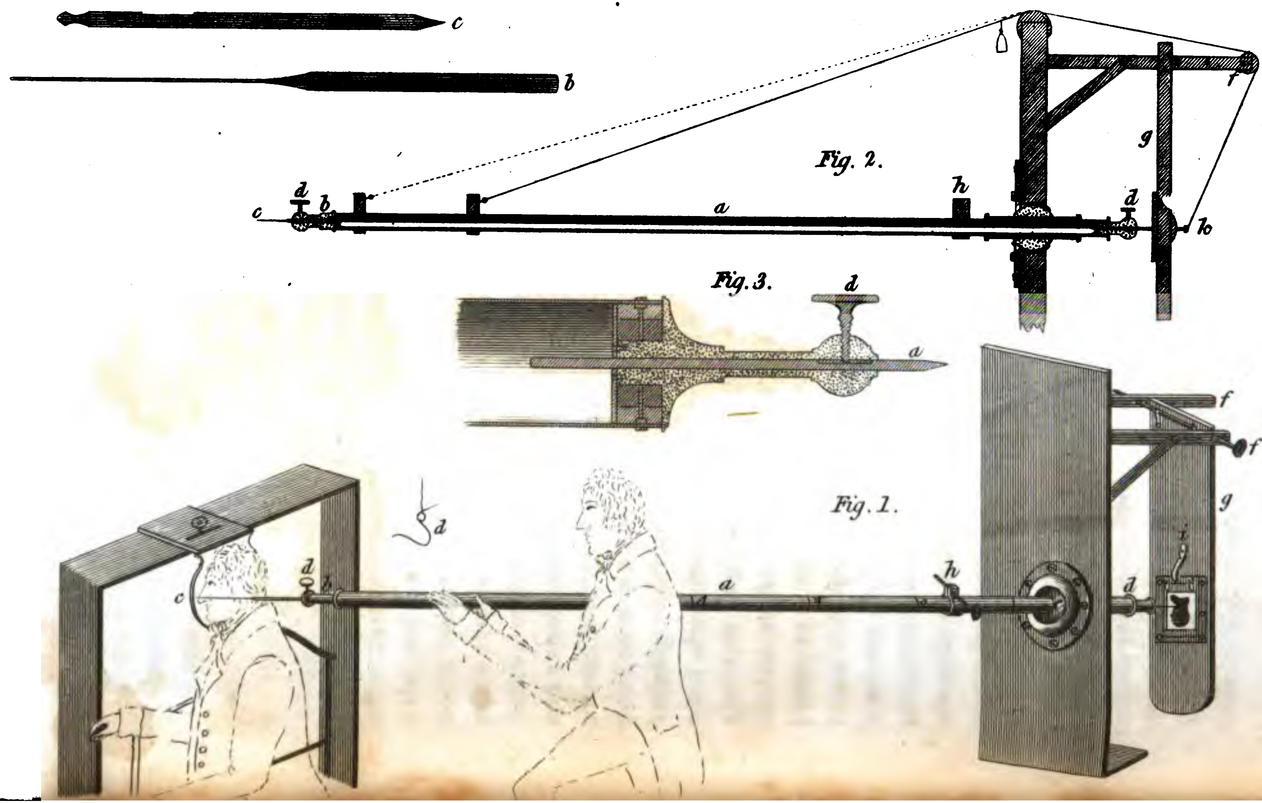


Fig. 1.

Fig. 2.

Fig. 3.

Specification of the Patent granted to JOHN BYWATER, *of the Town and County of the Town of Nottingham; for Improvements of certain Sails of Ships and other Navigable Vessels, and the working of the same.*

Dated August 22, 1806.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in conformity to the said proviso, I the said John Bywater do hereby declare my intention in the improvements of the sails of ships, and other navigable vessels, is to render them capable of being rolled, folded, or doubled, from the head of the sail, in an easy and expeditious manner, without the necessity of sending a hand aloft to do the same, leaving them firm at the point they are reefed and furled to; and, as the method of keeping or furling the sail by rolling it appears, on several accounts, to promise the greatest advantage, I begin with explaining that method; which is as follows. To the yard of the topsail, or top-gallant (see the drawing hereunto annexed, Plate XII.), I attach a roller, which I call the reefing-roller, Fig. 1, with ends of enlarged diameter *a a*, or of the same diameter, according to the power required, and the length of which roller between the ends of enlarged diameter on which the reefing ropes are to be applied, is equal to the width of the sail in that part to which I mean the reefing to extend. In order to admit a circular motion to the roller, these ends of it have gudgeons of iron, or any other proper material *b b*, with collars to keep them steady in the socket of the arms of iron, or any other proper material, Fig. 2 and *y y*, Fig. 3, fixed on the ends of the respective yards, and are kept in their place by pins *o o* passing over the gudgeons.

ons. On this roller the head of the sail is firmly fixed, so that the sail may be rolled thereon. In order to support the reefing roller, two friction rollers B Fig. 3, having gudgeons at their ends B B, Fig. 4, running in sockets in clamps, or iron, or other proper material, C C, Figs. 3 and 5, affixed by the bolt *d*, Fig. 5, to the yard. The relative situation of the friction rollers, with regard to the reefing roller, is such as to prevent its bending, and to keep it as nearly as may be in its whole length, and at all times parallel to the yard; that is, one of these friction rollers I place under and the other in front of the reefing roller, as at Fig. 6, by which means the reefing roller is preventd from bending either downwards or forwards, and the sail has a free passage between the friction rollers. These friction rollers I encrease in number, and vary in situation, according to the length of the reefing roller, as one or both ends of the reefing roller, according to the power, required. I fix a rope on the enlarged part, which I call the reef-line R, Fig. 6, and R R R R, Fig. 7, which, by passing over itself a number of times, according to the quantity of sail to be reefed, and in a contrary way to that in which the sail is rolled, enlarges the thickness at the end of the roller, and produces an additional liverage, which is greatest when the greatest power is required; that is, when the whole sail is set. This reef-line or lines being passed through a sheave or block, fixed under the yard S S, Fig. 6, and S S, Fig. 7, leads to other blocks L L, Fig. 7, near the centre of the yard, or over additional sheaves in the clue line blocks down the mast, to the deck. We will now suppose the sail to be set; it is necessary to take in a portion equal to one or more reefs. While the sail is yet full, without shiving the sails, I lower the yard, and as fast as the yard is lowered I haul

I haul in the reef-lines, till the portion required is reefed; I then make fast the halliard and the reef-line, and the part reefed remains firm on the roller. If I want to take in more canvas, I repeat the operation before described; but if more sail is to be set, the above operation is to be reversed, viz. the reef lines, are to be slackened off, and the yard is to be hoisted till the requisite quantity of sail is set. By the machinery and in the method above described I reef any portion not exceeding half the sail, and the rest I hand in the usual manner. In applying this machinery to the courses, I use the same method, except that as their yards cannot be lowered, the tacks and sheets must be started or cased off till the necessary quantity of canvas is taken in, and the remaining part handed as usual. In order to find or take in the whole of the sail, the rollers must be longer, and consequently the yard or dimension of the sail must be contracted at the foot, and rolled up from the top, in the manner above described. My method of doubling or folding is as follows. I take my square sail of the usual form, and attach it to the yard in the usual manner across the middle of the sail; or at the point to which I mean to reef I fix a strong reef-band *a a*, Fig. 9, on the after-part of the sail, to which I attached a rope similar to the head-rope *b b*, and which I call the reef head-rope, the ends of which are firmly seized into the leech-ropes, and form what I call the reef earings. To these earings I attach what I call the outer reef-lines C C, Fig. 9, and at equal distances on the head-rope I seize four other lines *d d d d*, or more or less, according to the width of the sail (so as to divide the sail into equal parts), which from thence lead through an equal number of half blocks *e e e e e e*, Fig. 10, fixed on the fore part of the yard, nearly perpendicular to the points where the reef lines *d d d d*, Fig. 9, are seized to the

the reef head-rope, but each rather inclining outwards, for the purpose of hauling and keeping tight the reef head-rope, when the reef is taken in. The outer lines *c c c c*, Fig. 9, lead to the mast in the same manner as the reef-lines in common use. The lines *d d d d*, Fig. 9, lead from the half blocks *e e e e e e* through blocks on or near the middle of the yard down the mast or shroud to the deck; or at a convenient distance, below the yard two or more are seized together, and led upon deck as one line, for the purpose of taking up less room. Suppose a top-sail or top-gallant to be set, and that it is required to take in a reef. The outer-reef-lines *c c*, Fig. 9, are first hauled taught and belayed, and then the yard is lowered till the points where the lines *d d d d* are seized to the reef head-rope, are hauled home to their respective half blocks *e e e e e e*, as in Fig. 10. When these are fastened below, I again haul taught the outer reef lines *c c*, and that part of the sail which is reefed hangs double before that part which is set. In order to prevent this double part from shivering when the vessel is going about, or close hauled on a wind, I attach two ropes which I call reef sheets *f f f f*, Fig. 10, to cringles in the lowest part of the leech-ropes of the part doubled, which lead with the sheets to the deck; when more sail is required to be set, I slack off the reef sheets *f f f f*, and the reef lines *c c*, and *d d d d*, Fig. 9, and haul taught the halliards. If I want to reef one of the courses on the doubling or folding plan, I slack off the sheets in proportion to the quantity to be reefed, and then haul the reef-lines taught home to the half blocks, as before described, and belay them. In taking in two reefs at different times, by the above method, I apply double the number of reef-lines attached to an additional reef band and reef head-rope; and if three reefs add another sett of reef-lines, reef-band,

and

Fig. 1.

Fig. 3.

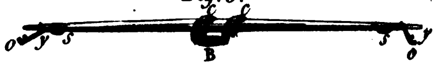


Fig. 6.

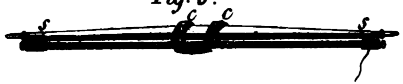


Fig. 2.

Fig. 4.

Fig. 5.

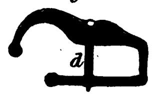


Fig. 7.

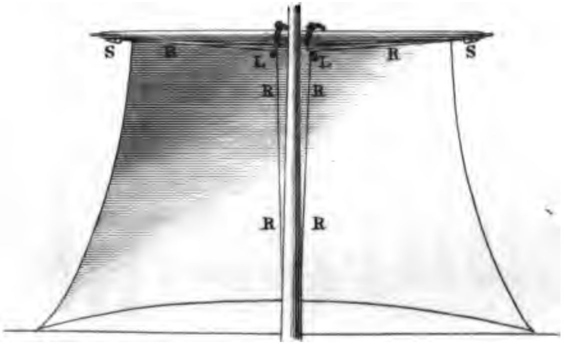


Fig. 9.

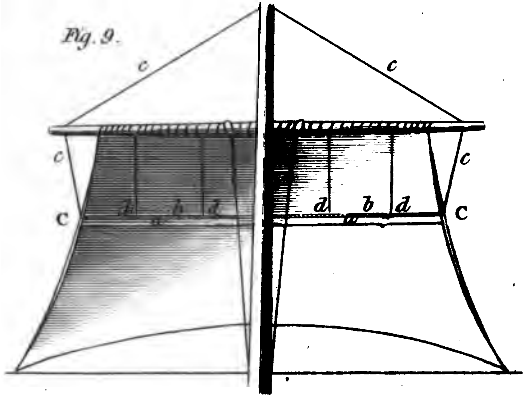
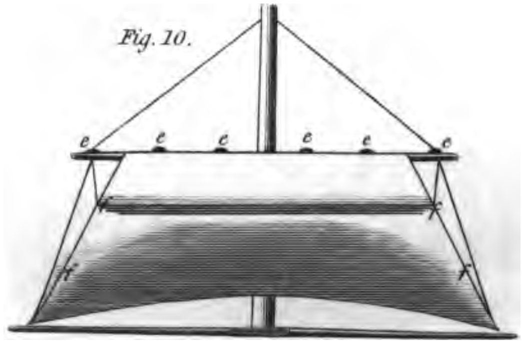


Fig. 10.



and reef head-rope, and work them as before described. By the above invention I reef or furl all square sails of whatever name or denomination, and use in working the same, also such other tackle and mechanical coutrivance as have been and are in common and ordinary use among seamen.

In witness whereof, &c.

Specification of the Patent granted to the Right Honourable ARCHIBALD *Earl of* DUNDONALD; *for Improvements in Machinery or Mill Spinning, for the Spinning of Cotton, Wool, Silk, Hemp, and Flax, and Substitutes for Hemp and Flax, which is also applicable to other useful Purposes.* Dated November 19, 1805.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Archibald Earl of Dundonald do hereby particularly describe and ascertain the nature of the said invention, and in what manner the same is to be performed, in manner following; *viz.* That the improvements on mill spinning machinery for which patents have been granted to me, consists principally in an alteration in the construction and position of the spindles. This is to be done in several different ways. The first method is here termed spindle No. 1. This spindle is in several respects similar to the common spindle, but it differs from it in one respect; namely, that the bobbing does not rest on or touch the copping rail, their contact being prevented by a brass or other worl or ring, made to fit, and to rise and fall, or traverse on the spindle, in which there is a groove cut length-ways, and in this groove a screw or pin is made to fit, which passes through the brass or other

worl, so that when the spindle is made to turn round, the worl must turn round with it. The worl is moved up and down on the spindle by a rail communicating with the heart or other motion. This rail fits into a groove, cut or turned in the brass or other worl, on which revolving worl, and not on the copping rail, the bottom of the bobbing rests. The uptake of the bobbin is regulated by applying to it a spring, band, weight, lever, or any other substance capable of retarding its revolution.

Spindle, No. 2. This spindle is similar in one respect to the one already described, inasmuch as the bobbin does not touch the copping rail, and that the bobbin is carried round by the spindle in a manner nearly similar. The flyer of the spindle does not unscrew. The haft or warf is not permanently fixed on the spindle, which draws through the haft when the bobbin is changed. The under part of the spindle is made square, or of any other figure different from that of a circle; and a corresponding shape is given to the interior part of the moveable haft, so that the spindle may correctly fit it. The same effect may be produced in many ways: for instance, by cutting a groove, length ways, in the lower part of the spindle, into which a screw or pin from the haft is to be made to fit, so that by this groove and pin the motion of the haft, when turned by the band, will be communicated to the spindle. The haft on which the band passes has small projecting shoulders, or ends; which, when the bobbin is changed, drop into rests, made in a rail or rails, which support the shifting haft with the band on it. On the upper shoulder of the haft the bobbin rests not on any copping rail, so that the bobbin is carried round and is retarded in the same manner as spindle No. 1. The spindle No. 2. has bearings at its two extremities. The upper end of the spindle has

has an eye in it like a foot-wheel spindle. It revolves in a circle or semicircle of brass, steel, or other substance, while the lower end of the spindle fits into a step similar to the common spindle. The bobbin does not rise and fall or traverse up and down on the spindle. The spindles are placed in a frame; which frame, containing the spindles, is by the heart or other motion made to traverse up and down, while the haft and bobbin may in one sense (excepting as to the revolving motion) be deemed stationary.

Spindle, No. 3. This is a compound of the two already described spindles. It has a groove cut in it length ways like spindle No. 1. It has likewise the brass or other revolving worl or ring on which the bobbin rests, with a pin to fit the groove. It has the shifting haft of spindle No. 2. Its flyer and spindle are in one like spindle No. 2.; consequently the flyer does not unscrew when the bobbin is changed, the spindle being made to draw through the shifting haft. The spindle is supported at its two ends in the same manner as No. 2.; but the frame in which the spindles are placed is fixed, and nothing moves up and down but the brass worl, the copping rail, and bobbin. The revolution of the bobbin is retarded as has already been described.

Spindle, No. 4. This spindle goes upon bearings at its two extremities, like spindle No. 2. and 3. Its haft or warf shifts or is removeable. The bobbin does not rest on a brass or other worl; but in the usual way. The retarding motion is given according to the methods now generally known or practised, or which may be hereafter adopted.

As it is extremely difficult to describe all the different varieties of spindles, whether made in one or in two pieces, I think it proper here to state, that the prominent

 features

features of the improvements I have been describing are; the making the spindle to carry round the bobbin without the action of the yarn or thread, and that whether the spindles be in one or more pieces: the making the haft or warf at times to shift or remove from off the spindle; the supporting of the spindle at its two extremities, and placing it in an inclined position, so as that the yarn or thread shall not in its direction form an angle with the rollers; the retarding the revolutions of the bobbin carried round by the agency of the spindle, so as to regulate the uptake of the yarn on the bobbin, by a power connected with the motion of the spindle, or with the action and pull of the yarn, as in the common spindle, in which last the uptake of the yarn is occasioned by the very yarn itself pulling or dragging round the bobbin, or, in other words, giving the bobbin the motion necessary to occasion the uptake of the yarn, which is directly contrary to the principles on which the improved spindle is constructed, in which the object is to retard the revolutions of the bobbin, and not to give it motion. Spindles such as have been described are in a preferable manner adapted for making covings; likewise for throwing and twisting thread or yarn of cotton, silk, wool, flax, and hemp, or other substitutes; likewise for twisting or laying sail twine, net twine, fishing lines, and all lines, twines, cords, and ropes, of any size or description. And these applications of the invention are included under the words of the patent; which states, and which is also applicable to certain other useful purposes.

In witness whereof, &c.

Specification

Specification of the Patent granted to ANTHONY GEORGE ECKHARDT, *of Berwick-street, Golden-square, in the County of Middlesex, Fellow of the Royal Society, and Member of the Society of Haerlem in Holland, for certain Improvements in the Mode of covering or inclosing Books, whereby their Contents will be secured from the Observation of any Person but the Owner, and will also be preserved from Injury.*

Dated December 22, 1806.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Anthony George Eckhardt do hereby declare, that my said invention consists in extending the idea and application of a principle invented by Messieurs John and Joseph Williams, for which they obtained his Majesty's royal letters patent in November 1799 *; which extended improvement has had the concurrence of, and been purchased by, Mr. John Williams, stationer, in Cornhill, in the City of London, the sole survivor in that patent right. And whereas the patent then obtained was for the express purpose of producing freedom in the opening of all sorts of books by means of a firm back, of whatever materials, applied to a book before it is covered, in the manner therein specified; now this my invention consists in producing the same effect upon all sorts of books after they are covered, bound, or finished (provided they are sufficiently pliant), by the same firm back applied externally; to which is attached, by hinges of any kind, a flap or flaps, made of the same or any other strong materials, to which flap or flaps are connected by hinges of any

* The ſpecification of this patent was inſerted in our 12th vol. p. 89.

any kind, ledges which completely inclose the book on all sides, resembling the appearance of a book. Withinside this firm box are placed stays or pivots, or indents, to hold down the cover of the book; which being confined upon the same principle as in the former patent, will cause the book so inclosed, when opened, to produce a flat or level surface.

My invention also consists in converting the ledges at the bottom, or on either side, to supporters for the hand when requisite to write near the bottom or edges of the book; which may be done by the ledges on that part of the covering where the rest for the hand is required having a joint, which shall extend across one or both sides of the book, so as to support the hand wherever it may be necessary to write. And these rests possess an ability to elevate or depress their position at pleasure, with a power of being rendered stationary, by means of a stop or stops which are affixed to the flaps, or for any other means by which these advantages can be procured. The whole to be secured by a lock or other fastening.

This invention I think will prove of great importance to every one using books, whether for reading or writing in, as it will be a perfect and durable covering from dust and injury, it will present a flat and level surface when opened, and also be secure from inspection. It may be made very light and portable, and of any materials more or less expensive; applicable to any number of books in succession, as one may be removed and another placed instead in an instant; and always possessing the same advantages. It will likewise become a preserver from fire or mischief when made of proper materials to resist them, and may also be made to contain papers and other articles.

In witness whereof, &c.

Specification

Specification of the Patent granted to William Bell, *of the Town of Derby, in the County of Derby, Engineer; for an improved Method of making Smoothing Irons or Sad Irons, Plane Irons, and various Edge Tools.*

Dated December 22, 1806.

With a Plate.

To all to wbom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said William Bell do hereby describe the nature of my invention, as follows: The articles which bear the different appellations of smoothing irons, sad irons, and flat irons, and which are commonly made use of for ironing or smoothing washed linens, muslins, and other articles, have been frequently complained of for being defective in their construction, but which defects are intended to be obviated by my improvements, as hereinafter described; that is to say: First, in the necessary operation of heating the said irons they become smoaked and dirty, so as to require considerable trouble in rubbing and cleansing before they can be properly made use of; and, secondly, they are very frequently over-heated, so as to damage or endanger the linens, muslins, or other articles they are used upon. Now, to prevent such inconveniences, I have formed a thin case or slipper, as described in the drawings hereunto annexed (see Fig. 1. Plate XIII.); which case or slipper I make of steel, wrought or cast iron, or any other metallic substance or substances, and polish the face of the said case or slipper so as to render it smooth, neat, and clean: I also fit it up with a spring or other fastenings, for the purpose of securing it to the sad iron with which it is intended to be used (see perspective drawing Fig. 2). The said case or slipper being thus completed, I then introduce my sad

iron

iron properly heated into it, which being made of thin metal quickly becomes sufficiently penetrated with heat, and rendered fit for its intended purpose. Another inconvenience complained of in the common sad iron is that the handle thereof, which is generally made of wrought iron, being affixed in such manner that it cannot be separated from the body or cast iron part to which it is connected, naturally becomes hot at the same time when the body of the iron is heated, so as to require what is generally termed an ironholder to prevent its burning the hand. But to remove this objection, I make a handle or handles, as described at drawings Figs. 3, 4, and 5, which I quickly connect or separate from the heavy or cast part of the iron during the time of its being heated; the advantage is, that I avoid the usual incumbrance of an ironholder. My improvements in making plane irons, and various edge tools, I describe as follows: I take either wrought iron, cast iron, or any other of the metals or their compounds, which I either hammer, roll, or cast into the suitable forms or shapes, for the purposes hereinafter described. As for instance, in making my plane iron, blank or stock, from any of the aforesaid materials, I leave a vacancy, which will appear by reference to drawing Fig. 6, which vacant part in said drawing is painted blue*, and is intended to be filled up by a thin piece of steel made exactly to fit it, as marked in the drawing Fig. 7. I then tin the two parts which are intended to be connected together, and for the purpose of uniting them, I run between them any kind of solder, which does not require an extreme heat to render it fusible. The steel may be connected by various other sorts of solder, but I prefer powder solder, or what is called soft solder; my reason for which is, that, having previ-

* The colouring is necessarily omitted in the plate, but the part is marked A.

ously

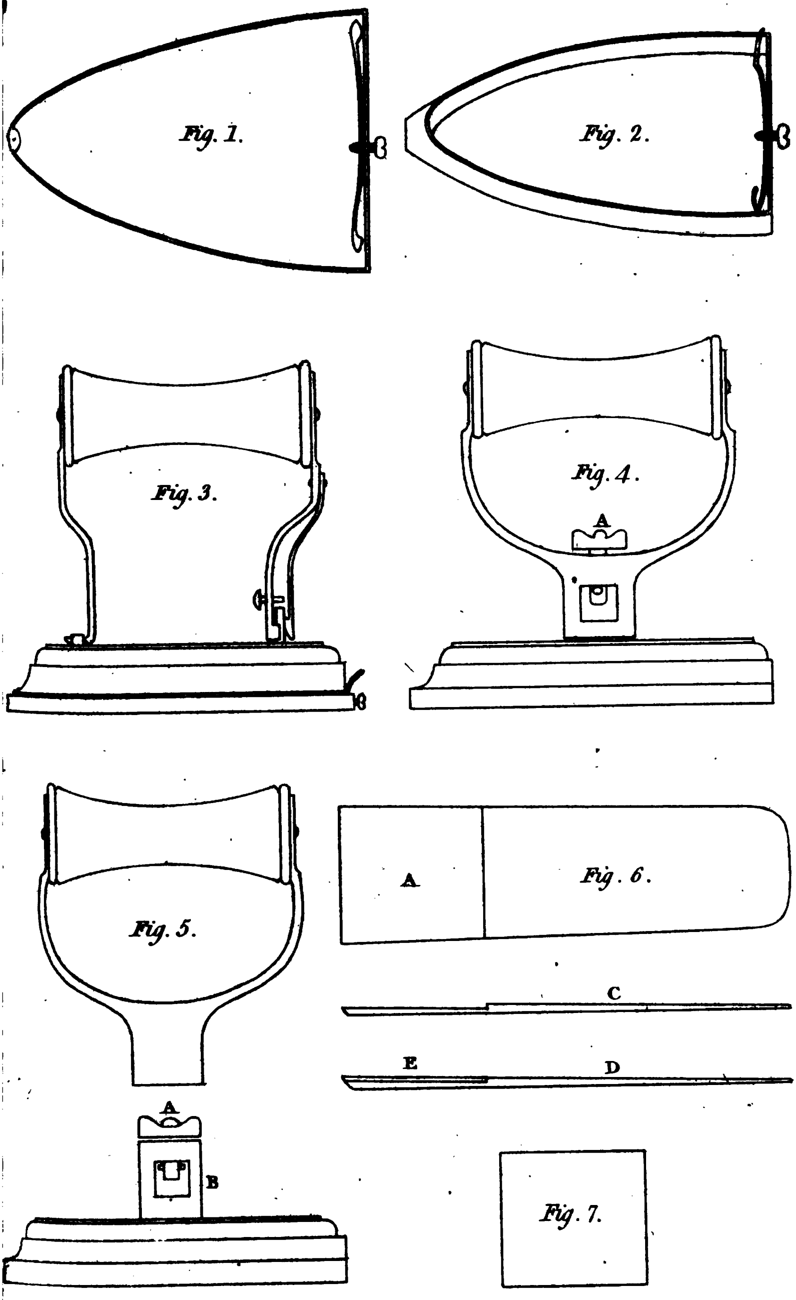


Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
A
Fig. 5.
A
B
A
Fig. 6.
C
E
D
Fig. 7.

ously hardened and tempered, my piece of steel, Fig. 7, that solder which requires the smallest heat to bring it into fusion, causes the least injury to the temper of the steel. Yet the steel may be soldered to the iron or metal back in a soft state, and afterwards hardened. The usual method of connecting steel to iron, by means of welding, requires so severe a heat that it evidently injures the quality of the steel, which by my improvement will be preserved in its best possible state. By the same method of connecting my steel to iron or metals as before described for plane irons, so do I intend manufacturing chissels, and various other edge tools.

EXPLANATION of the DRAWINGS.

(Plate XIII.)

Fig. 1 represents the plan of the case or slipper with a spring or screw. Fig. 2 the perspective view of Fig. 1. Fig. 3 one method of making and connecting, and making a handle by loops and spring catch to the last part intended to be heated with its case or slipper on. Fig. 4 is another form and method of connecting a handle by a nutt or turn button marked A. Fig. 5 represents the handle Fig. 4, when separated from the bed of the iron is marked B. Fig. 6 shews the form of one sort of plane irons; the part A, which I have termed the vacant part, is that on which the plate of steel marked Fig. 7 is intended to be soldered; letter C shews the section, or side view of the plane iron blank before the steel is soldered on; D the section or side view after the steel is connected as soldered on; the blue line shews the edge of the steel, *(marked E)*.

In witness whereof, &c.

An Essay on the Cultivation of Potatoes.

By the Rev. EDMUND CARTWRIGHT.

(Concluded from Page 221.)

VI. On the Advantage of transplanting Potatoes.

POTATOES have a great advantage over most other crops in the latitude they admit of in the article of planting them. From the middle of February till the beginning of June, a period of nearly four months, the farmer may chuse the time most suited to his convenience for putting them into the ground. But this is not all; there is no plant which admits of being transplanted with greater success.

On May 11th, 1804, I planted six rows of the American hundred eyes. On the 7th of June three of the rows were taken up and transplanted. The transplanted rows produced 375 lbs. after the rate of 1lb. 9 oz. from each root. Those which were not removed pruduced 360lbs. after the rate of 1lb. 8oz. from each root. The soil in each instance was the same. That part where the potatoes were originally planted was manured at the time of planting; where they were transplanted, a top-dressing only was given.

On the 4th of June I planted three rows of a smallish round white potatoe, and at the same time some of the same kind were planted in a nursery bed. The latter were transplanted the 1st day of July. The produce not inferior to those which had never been removed.

On the 8th of June I planted three rows of the early Scotch kidney (a very good sort, which Sir John Sinclair procured out of Scotland for the Board of Agriculture, at the time he was President), and on the same day some of the same kind were planted in a nursery bed. Those in the nursery bed were transplanted on the 11th of July. The

The potatoes which were not removed, produced a fair crop; the transplanted ones were very small. They ripened, however, at the same time when the others did. I attribute their failure not so much to their having been transplanted at a late season, as I do to the operation having taken place in uncommonly dry weather. And yet, though they were transplanted under every disadvantage, in a hot dry sand, and at a time that was both preceded and followed by great drought, not two plants out of the whole number died. The potatoe, indeed, is a plant more tenacious of life, if possible, than couch-grass. I have no doubt, had the season been favourable, the crop would have equalled that which had not been transplanted.

Potatoes may also be propagated from cuttings of the haulm, which very freely take root, especially if the season be favourable.

When thus propagated, the same room should be allowed as in any other way of raising them; for though they are not quite so prolific (at least I do not find them so) as transplanted plants, yet their tops are equally as luxuriant.

My experiments on transplanting were tried on a piece of ground which had produced a crop of winter tares. As soon as the potatoes were off, it was sown with winter tares as before; and as soon as the tares are mown in the ensuing summer, it is my intention to fill it with transplanted potatoe plants again.

This practice, besides suggesting hints to the farmer, may furnish valuable information to the small cottager. It will teach him, that after his little garden has produced him a crop of spring and early summer vegetables, he may obtain from it, by being provided with a nursery bed of potatoe plants, a valuable stock of food for his winter consumption.

VII. *Taking up and Storing.*

In taking up potatoes, the first thing to be attended to is to clear the ground of the haulm, and then to gather such potatoes as appear on the surface. These, though of inferior quality to the rest for culinary purposes, are as good as the best for sets.

Potatoes are taken up either with the spade or fork, or else with the plough. The one mode is more expeditious, though in some respects more wasteful.

When taken up by the plough, supposing they are planted in single rows, a common swing plough is the best implement, which, when applied to this purpose, should work without a coulter. When the potatoes are planted in double rows, as is recommended in this paper, the proper instrument is the double mould-board plough, drawn by two horses, the horses going abreast with the ridge between them, which the double mould-board plough undermines. In performing this work it should commence by undermining only every other ridge. The produce of these being cleared away, the remaining ridges are then to be proceeded upon in the same manner.

The persons employed to gather the crop should be supplied with two, if not three baskets, for the purpose of separating those of prime and middling quality from the refuse.

Previously to their being stored, they should be spread abroad for two or three days, that they may be perfectly dry; lest when they are laid by, whether in a pit or elsewhere, they should ferment and be spoiled.

Two things are to be attended to in storing potatoes, namely, that they are kept dry, and that they are out of the reach of frost. The most common way, where they are raised in large quantities, is to put them into what are

called

called pies. These are trenches from five to six feet wide (the narrower the better) and usually about one deep. Their length of course must be determined by the quantity to be stored. These trenches are to be made where no wet can drain into them. The sides being lined with straw, the potatoes are laid in, and ridged up about two feet and a half or three feet high, like the roof of a house. The whole is then covered with dry straw at least a foot thick, and on that is laid the earth which came out of the trench, and as much more as may be necessary completely to exclude the frost.

The earth is carefully to be beaten down, and laid with such a declivity as that the rain may not soak in.

VIII. *On the Application of Potatoes as Food for Animals.*

Much has been said and written on the best and cheapest mode by which potatoes may be prepared as food for animals. Though I differ from most writers on this subject in supposing that simple boiling, all circumstances considered, is perhaps as cheap a way as any by which they can undergo a culinary process; yet as to boil them properly requires an attention which is not to be expected from common farming servants, I should prefer either steaming, roasting upon kilns, or baking. By any of these processes the watery particles are dissipated, without the chance or possibility of being reabsorbed, as will inevitably be the case in boiling, unless they are taken out of the water before the ebullition subsides.

It were presumption to say that where potatoes are cultivated upon a great scale, and where fuel is exceedingly cheap, and where the expense of buildings, apparatus, &c. is not an object (but where is it not an object?) potatoes may not be cooked to advantage. I am, however, decidedly of opinion that it will never answer

the

the purpose of farmers in general to adopt the practice, I mean beyond what can be done by the farmer's wife (if she will condescend to such employment) or dairy maid, in the common routine of business, without interfering with their regular work; and this could only extend to a few hogs in the stye.

The practice which I recommend is to give them raw, and in moderation, giving at the same time dry food, particularly such as will most powerfully counteract their purgative tendency.

They are found to agree with animals of all kinds best when in a growing state; for when they begin to vegetate, the saccharine matter is developed, and the juices undergo a decomposition, which in a great measure, if not altogether, disarms them of their deleterious quality.

Let a calculation be made of the expense of fuel, attendance, buildings, apparatus, &c. then let an equal sum be expended in corn and oil-cake to be given with the potatoes; and at the same time let an estimate be made of the value of the increased quantity and quality of the dung in consequence of such addition of corn or cake. When this is done, see on which side will be the balance.

The most valuable purpose to which the farmer can apply his potatoes, when he has no longer a market for them, is to give them to his sheep at those times when they are prevented by frost or snow from getting at the turnips. In this way they are applied with great advantage. Late in the season also they are an admirable resource to fly to, at that distressing period when the winter food is consumed, and before the spring grass has made its appearance.

Potatoes are particularly serviceable for ewes and lambs. To these I give them after the rate of two, three, and

and sometimes four pounds per head per day. But whether they are given to ewes and lambs, fatting, or other sheep, neglect not to supply the flock with plenty of dry food at the same time.

It is said that in Lancashire, and some other parts, it has of late years been customary to give potatoes bruised or ground, mixed with meal of some kind, or pollard, to cows and hogs. There can be no objection to this method, except the trouble of executing it. But where there are proper conveniences for the purpose, I should prefer it to any other mode, for cows especially, as there would then be no risk of their being choaked, as sometimes happens when potatoes are given to them whole.

IX. *Diseases.*

The only disease to which potatoe plants are particularly subject is what is called the curl. It's appearance and effects are too well known to need a description. About five and twenty years ago this disease was alarmingly extensive: since then it seems gradually to have abated. Various have been the opinions concerning it, but none which carry with them complete conviction. The opinion which I lean to (and I only lean to it) is, that the disease is hereditary; in the same sense, I mean, as certain diseases are hereditary in certain families, which though they do not regularly appear in every generation, yet are always liable to break out on the slightest agency of the exciting cause. One circumstance which tends to favour this opinion is, that some sorts, the ox-noble for instance, were never infected with this disease. I have remarked that the sets producing curled plants seldom dissolve, coming up in autumn to all appearance in as perfect state as when first deposited in the ground.

It has been said, and, if I mistake not, I once proved

it by experiment, (but as it is many years since, and as I took no memorandum of the fact at the time, I cannot trust to the accuracy of my recollection,) that a potatoe, which cuts hard or woody, will infallably produce curled plants, and such as yield freely to the knife, may be expected to produce healthy ones.

X. *General Observations.*

It is a received maxim that the same crop ought not to be grown on the same land for a succession of years, under the idea, I suppose, that to bring any particular vegetable to maturity requires a specific kind of nutriment, of which in a short time the soil would be exhausted, were it to produce the same species of plant annually. There is reason to believe that this idea is erroneous. I mean not, however, to say that a rotation of crops is not in general beneficial, and in most cases even necessary.

A rotation of crops enables the farmer to repair the exhaustion of one crop, which is reaped and carried off the ground, by the interposition of another, which being manured for, and consumed upon the land, brings back as much as the preceding one had taken away. Besides a rotation of crops, of which turnips and vegetables of that tribe make a part, gives time for eradicating couch-grass and other weeds, which will unavoidably accumulate amongst every kind of grain which admits not of garden culture. Were it practible to cultivate even wheat, so as that the crop could be produced every year perfectly free from weeds, the same grain might be repeated *ad infinitum* by the assistance of sufficient manure to make good the annual exhaustion of the soil.

This reasoning is confirmed by the practice of the potatoe farmers in Yorkshire. In Marshland, a district in that country, which supplies the London market with the

greatest

greatest part of its potatoes, it is customary to plant potatoes in the same field for twenty years in succession, manuring for them every other year. No complaints are made, that the crops are less productive now than they were formerly, or that the potatoes degenerate.

It may not be improper, however, to remark, that it is more than probable that every agricultural plant would not admit of being cultivated in the same field for a series of years like potatoes. Such plants, for instance, as are liable to be infested by particular insects, ought not to be repeated too often in the same field; as the insects it is reasonable to conclude, would multiply in a soil which regularly supplied them with food; for it is a natural supposition that where the insect finds its food, there it will deposit its eggs, or remain buried in the ground in its larva state till the returning season.

Upon this principle, perhaps, we may account for the circumstance respecting red clover, taken notice of in many parts of Suffolk and Norfolk, namely, that the land, as the farmers there express themselves, is grown tired of it. It is not improbable, that some insect, too minute for general observation, and which for a number of years has been increasing in the soil, may prey upon the young fibres of the root, or some other delicate part, so as either to destroy the plants, or to render them weak and sickly. Should this reasoning be conclusive when applied to red clover, which is never repeated oftener than once in every four years, it must appear still more conclusive when applied to insect-feeding plants repeated on the same soil every year.

It is generally supposed that the colour of the potatoe blossom depends upon the colour of the potatoe; that a white blossom, in short, is a certain indication that the potatoe to be produced will be white, and that the purple

blossom as infallibly shews that it will be red. This, however, is a mistaken supposition; the white blossom invariably indicating that the potatoe which produces it is of the kidney kind; the blossoms of the red being only of a darker hue. There is, I believe, no instance of a true kidney-shaped potatoe being red.

Having in a preceding part of this paper spoken of the potatoe as a plant remarkably tenacious of life, it may not be improper to mention that it possesses also a principle of vitality, or self-propagation, which few persons, it is believed, suspect.

In looking over some potatoes which were going to be planted, I observed on several of them small buds breaking out where there was no appearance of an eye: these I cut out and planted, all of which grew and produced potatoes. Willing to trace this principle of vitality and self-propagation to its source, I took a certain number of potatoes, which, after paring off the rind, I cut into cubes of about an inch square. These cubes being kept in a dry place for a day or two, that they might heal over, were planted in the same manure as common cuttings. Of these, two-thirds at least produced healthy vigorous plants, and came to maturity.

How is this phænomenon to be accounted for? Do the embryo plants extend themselves in all directions from the eyes through the whole parenchymatous substance of the potatoe, converting it, as it were, into a vegetable polypus? There is nothing obvious to the eye, at least, which leads to any such hypothesis.

Had this plant and its properties been known to the Egyptians, they would, probably, have consecrated it to their principal divinity, not only on account of its important application to the sustenance of human life, but as a symbolical instance of the mysterious obscurity of nature

nature in the generative process, to which their mythology is perpetually allusive, and as an emblem of fecundity.

Potatoes, for domestic purposes, are best taken fresh out of the ground as they are wanted. Those persons, therefore, who are particularly curious in having this vegetable in its highest state of perfection, should have them taken up only as they are called for. It seems needless to observe that before winter sets in, they should be carefully covered over with straw, or any other protecting substance, to secure them from the frost.

It may not be amiss to mention, that potatoes for the table are much improved by being boiled in milk, especially if they are of the watery kind. The reason seems to be, that milk requiring a greater degree of heat to bring it to the boiling point than the watery part of the potatoe, the watery part of the potatoe is exalted into vapour and expelled before the milk boils; and even should the potatoe remain in the vessel, which it ought not to do after the ebullition ceases, it would absorb, and be saturated by the milk only, receiving back none of its own juices, as it would have done in part, had it been boiled merely in water.

It may, perhaps, be unnecessary to observe, that to give a minute detail of all the various modes of cultivating potatoes, which have been adopted in different parts of the kingdom, makes no part of the business of this essay. Had such, indeed, been my object, I might have compiled and put together nearly as many volumes as I have now written pages, and (the manual labour excepted) with as little trouble. But such an occupation would have been a needless waste of time, a mere repetition of what has been repeatedly communicated to the publick already. I thought it sufficient, therefore, to describe

those modes and operations which have had the preference in my own practice: some of which, so far at least as I have seen or heard, are peculiar to myself. It has not, however, been from any affectation of singularity that I have in any instance deviated from established customs or opinions. In agriculture, as in all other arts, those practices only are worth adopting which have utility for their basis. Of that, which has no other title to notice than its novelty, it is a slender commendation to say that it is new.

Description of an improved Book-case Bolt.

By Mr. PETER HERBERT, *of Bow-street, Covent-Garden.*

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Ten Guineas were voted by the Society for this Invention.

I HAVE taken the liberty of laying before the Society a model of my invention, which I hope is sufficient to explain my intention. I intended it for a library book-case-bolt, to facilitate the opening of both doors at once, and to secure the same, without the trouble of bolting two bolts in the common way. It will do for wardrobes, French casements, or folding sash-doors. It will also make a good sash fastening, if let into the bottom sash, with a small brass knob to slide as common; it would bolt in the frame by the side of the sash cord, both sides at once. I can also make it to answer sundry other useful purposes if required.

REFERENCE

Reference to the Engravings.

KL, Fig. 1, (Plate XIV.) represent the two stiles of the doors of a folding book-case. M the key-hole of a lock with two bolts, which are more clearly shewn at Fig. 2, where the back of the lock N shews the two bolts of the lock pressing back a sliding-piece O; on the front part of this sliding-piece in Fig. 1, two small friction rollers are placed at P, in the act of pressing against two levers, crossing on one common fulcrum R, to each end of which shorter levers S S above and below are connected by joints. These short levers act upon two long bolts, whose extremities are shewn at T T, having each a helical spring at V V. In the state as engraved, the doors are locked and bolted.

On drawing back the bolts of the lock by means of the key, the helical springs V V press against the plates U U, through which the long bolts pass; they force back the long bolts and sliding-piece O, and allow both the doors to open.

Description of a Stop or Check to Carriage-Wheels on Rail-Roads. By Mr. Charles Le Caan, *of Llanelly, in Carmarthenshire.*

With Engravings.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Ten Guineas were awarded to Mr. Le Caan *for this Invention.*

The model of a rail-road waggon and check or stop, which I have the honour of presenting to you, I trust, on examination will be found to possess the means of preventing

venting those various accidents which have from time to time proved fatal to the horses employed in such service, particularly where the declivity is from twelve to sixteen inches to the chain, and the trade on such road principally descending.

The use of a horse employed on a rail-road is as frequently to check the velocity of a waggon or waggons loaded, (generally to the weight of two tons and a half each.) so as that they may not exceed a certain degree of motion, as well as to draw them on such parts of the road as approach near upon, or quite to a level. When the horse finds himself pressed upon beyond his power of resistance, to relieve himself, he is compelled to quicken his pace, by which means the velocity of the waggon exceeds any government during the continuance of the declivity, which gave it such action: under such circumstances, the least trip of the horse terminates in a fall, by which, from the formation of a rail or tram road, the animal becomes injured, notwithstanding every manual exertion. For the preservation of that valuable animal, and as a preventive to all such accidents in future, I turned my thoughts to the invention of the simple check or stop now before you, and which may be appropriated to carriages in general use.

As the utility of rail-roads daily increases in the opinion of the public, I trust every invention that may perfect such a system, will add in some degree to its value, and aid in its advancement to perfection, an object so desirable as the conveyance of every species of merchandise, and so requisite in a commercial country.

Reference to the Engravings.

A, Fig. 3, (Plate XIV.) a rail-road waggon. B, the shafts in the direction as when drawn by a horse. C,C the

Fig. 1.

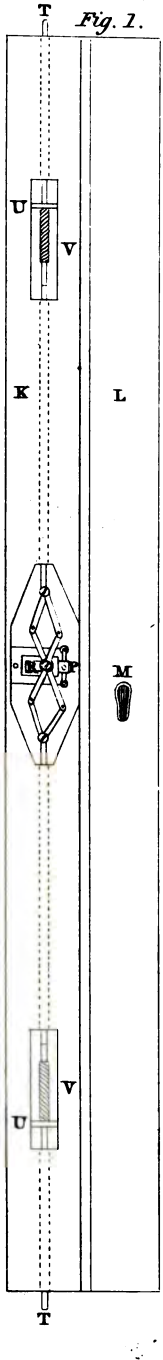
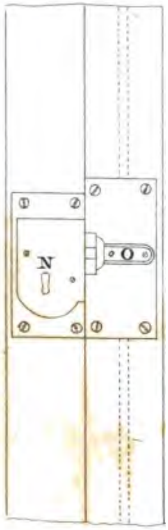


Fig. 2.



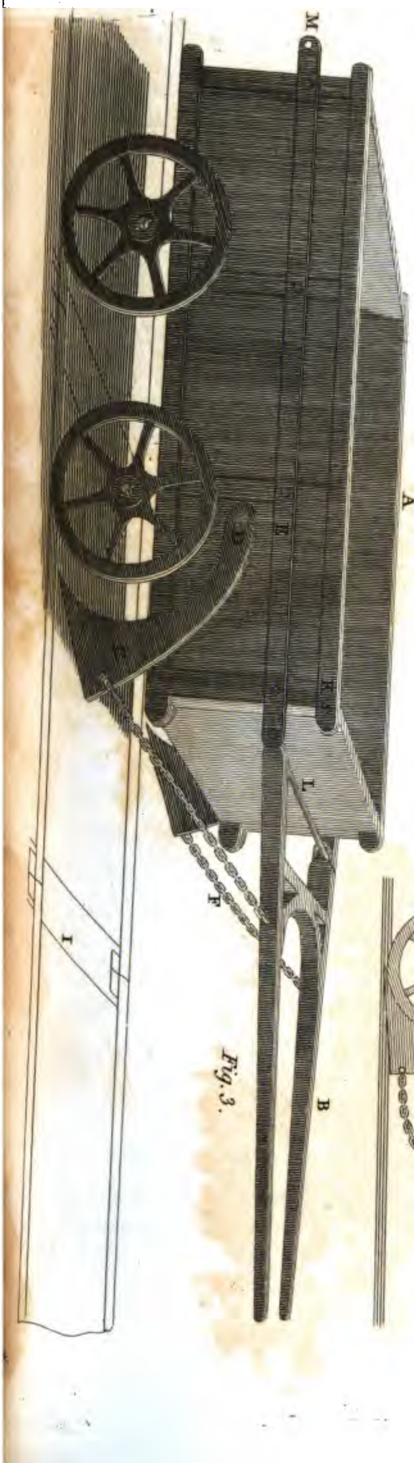


Fig. 3.

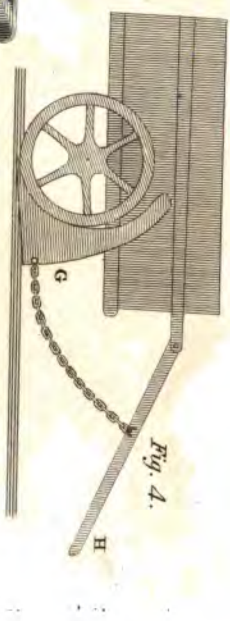


Fig. 4.

Venetian masters, owed the peculiar harmony, brightness, and durability, of their beautiful productions.

I have also a method of purifying oil for painters' use, agreeably to the practice of the antient masters; and I have prepared many mineral colours, which will never change, and may be used either in oil or water.

I have been enabled to produce crayons, of a quality greatly superior to any in use, and which are fixed, so as to prevent their rubbing off the paper when used, and which may also be applied in water or oil.

The utility of the above preparations can be fully proved, by the united testimony of the members of the Royal Academy, by noblemen, and by artists in general. The materials of which they are composed are extremely cheap, very easy to be procured, and none of the processes for preparation at all difficult.

Method of preparing Pannels for Painters.

Take the bones of sheep's trotters, break them grossly, and boil them in water until cleared from their grease, then put them into a crucible, calcine them, and afterwards grind them to powder. Take some wheaten flour, put it into a pan over a slow fire until it is dry, then make it into a thin paste, add an equal quantity of the powdered bone-ash, and grind the whole mass well together: this mixture forms the ground for the pannel.

The pannel having been previously pumiced, some of the mixture above mentioned is rubbed well thereon with a pumice-stone, to incorporate it with the pannel. Another coat of the composition is then applied with a brush upon the pannel, and suffered to dry, and the surface afterwards rubbed over with sand-paper.

A thin coat of the composition is then applied with a brush, and if a coloured ground is wanted, one or two coats

coats of the colour is added, so as to complete the absorbent ground.

When it is necessary to paint upon a pannel thus prepared, it must be rubbed over with a coat of raw linseed or poppy-oil, as drying oil would destroy the absorbent quality of the ground; and the painter's colours should be mixed up with the purified oil hereafter mentioned.

Canvass grounds are prepared by giving them a thin coat of the composition, afterwards drying and pumicing them, then giving them a second coat, and lastly a coat of colouring matter along with the composition.

The grounds thus prepared do not crack; they may be painted upon a very short time after being laid, and from their absorbent quality, allow the business to be proceeded upon with greater facility and better effect than with those prepared in the usual mode.

Method of purifying Oil for Painting.

Make some of the bone ashes into a paste with a little water, so as to form a mass or ball; put this ball into the fire, and make it red hot; then immerse it for an hour in a quantity of raw linseed oil, sufficient to cover it: when cold, pour the oil into bottles, add to it a little bone-ash, let it stand to settle, and in a day it will be clear and fit for use.

White Colour

Is made by calcining the bone of sheep's trotters in a clear open fire, till they become a perfect white, which will never change.

Brown Colour

Is made from bones in a similar manner, only calcining them in a crucible instead of an open fire.

Yellow Colour, or Masticot.

Take a piece of soft brick, of a yellowish colour, and burn it in the fire; then take for every pound of brick, a quarter of a pound of flake-white, grind them together and calcine them; afterwards wash the mixture, to separate the sand, and let the finer part gradually dry for use.

Red Colour, equal to Indian Red.

Take some of the pyrites usually found in coal-pits, calcine them, and they will produce a beautiful red.

Grey Colour

Is made by calcining together blue slate and bone-ashes powdered, grinding them together, afterwards washing them, and drying the mixture gradually.

Blue Black

Is made by burning vine-stalks in a close crucible in a slow fire, till a perfect charcoal is made of them, which must be well ground for use.

Crayons

Are made of bone-ash powder mixed with spermaceti, adding thereto the colouring matters. The proper proportion is, three ounces of spermaceti to one pound of the powder. The spermaceti to be first dissolved in a pint of boiling water, then the white bone-ash added, and the whole to be well ground together, with as much of the colouring-matter as may be necessary for the shade of colour wanted. They are then to be rolled up in the proper form, and gradually dried upon a board.

White Chalk,

If required to work soft, is made by adding a quarter of a pound of whitening to one pound of the bone-ash powder,

powder; otherwise the bone-ash powder will answer alone. The coloured chalks are made by grinding the colouring-matter with bone-ashes.

Certificates from Sir William Beechy, Mr. Benjamin West, Mr. John Opie, Mr. Martin Archer Shee, Mr. James Northcote, Mr. Thomas Lawrence, Mr. Jos. Farrington, Mr. Richard Cosway, Mr. P. J. De Loutherbourg, Mr. Richard M. Paye, and Mr. Isaac Pocock, confirm the good qualities of the Pannels prepared by Mr. Grandi, and generally recommend Mr. Grandi's colours as useful and permanent.

Account of Mr. CURWEN's *Method of Feeding Cows, during the Winter Season, with a View to provide poor Persons and Children with Milk at that Time.*

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

EVERY attempt to ameliorate the condition of the labouring classes of the community is an object not unworthy of public attention; and has on all occasions been zealously patronised by the Society of Arts. Under this impression I hope for the indulgence of the Society in calling their attention to an experiment, which I flatter myself will in its consequence prove not only highly beneficial to the lower orders of society, but tend likewise to the advancement of agriculture.

There is not any thing, I humbly conceive, which would conduce more essentially to the comfort and health of the labouring community and their families, than being able to procure, especially in winter, a constant and

and plentiful supply of good and nutritious milk. Under this conviction, much pains have been taken to induce the landed proprietors to assign ground to their cottagers, to enable them to keep a milch cow. The plan is humane, and highly meritorious; but unfortunately its beneficial influence can reach but a few. Could farmers in general be induced from humanity, or bound by their landlords to furnish milk to those, at least, whom they employ, it would be more generally serviceable. Even those who have the comfort of a milch cow would find this a better and cheaper supply, as they can seldom furnish themselves with milk through the winter. The farmer can keep his milch cows cheaper and better; for, besides having green food, his refuse corn and chaff of little value, are highly serviceable in feeding milch cows.

My object is to combat the prevailing opinion, that dairies in summer are more profitable than in winter. I confidently hope to establish a contrary fact. The experiment I am about to submit to the Society, is to prove, that by adopting a different method of feeding milch cows in winter, to what is in general practice, a very ample profit is to be made, equal if not superior to that made in any other season.

I believe the principle will hold good equally in all situations: my experience is confined to the neighbourhood of a large and populous town.

The price of milk is one-fifth higher in winter than in summer. By wine measure the price is 2*d.* *per* quart new milk, 1*d.* skimmed.

My local situation afforded me ample means of knowing how greatly the lower orders suffered from being unable to procure a supply of milk; and I am fully persuaded of the correctness of the statement, that the labouring poor

poor lose a number of their children from the want of a food so pre-eminently adapted to their support.

Stimulated by the desire of making my farming pursuits contribute to the comfort of the public, and of those by whose means my farm has been made productive, I determined to try the experiment of feeding milch cows after a method very different to what was in general practice. I hoped to be enabled thereby to furnish a plentiful supply of good and palatable milk, with a prospect of its affording a fair return of profit, so as to induce others to follow my example.

The supply of milk, during the greatest part of the year, in all the places in which I have any local knowledge, is scanty and precarious, and rather a matter of favour than of open traffic.

Consonant with the views I entertained of feeding milch cows, I made a provision of cabbages, common and Swedish turnips, Kholrabi, and cole seed. I made use also of chaff, boiled, and mixed, with refuse grain and oil cake. I used straw instead of hay for their fodder at night.

The greatest difficulty, which I have had to contend with, has been to prevent any decayed leaves being given. The ball only of the turnip was used. When these precautions were attended to, the milk and butter have been excellent.

Having had no previous knowledge of the management of a dairy, my first experiment was not conducted with that frugality requisite to produce much profit.

I sold the first season, between October 1804 and the 10th of May 1805, upwards of 20,000 quarts of new milk. Though my return was not great, I felt a thorough conviction that it proceeded from errors in the conduct of the undertaking, and that, under more judicious management,

ment, it would not fail of making an ample return, which the subsequent experiment will prove. In the mean time I had the satisfaction of knowing, that it had contributed essentially to the comfort of numbers.

In Oct. 1805, my dairy recommenced with a stock of 30 milch cows; a large proportion of these were heifers; and in general the stock was not well selected for giving milk; for they were purchased with a view of their being again sold as soon as the green crop should be exhausted. If the plan be found to answer under such unfavourable circumstances, what may not more experienced farmers expect?

By the end of this present month I shall have sold upwards of 40,000 quarts of milk.

The quantity of food, and its cost, are as follow. The produce of milk from each cow upon 200 days, the period of the experiment, is calculated at no more than 6 wine quarts in the 24 hours: this is to allow for the risk and failure in milk of some of the heifers. A good stock, I have no doubt, would exceed 8 quarts in the two meals, which would add 100*l.* to the profit.

Daily cost of feeding one milch cow:

	£.	s.	d.
Two stone of green food (supposing 30 tons of green crop on an acre at ¼*d.* *per* stone, would pay 5*l.* *per* acre) at ¼*d.* *per* stone of 14lb. -	0	0	0½
Two stone of chaff boiled, at 1*d.* *per* stone -	0	0	2
Two lbs. of oil cake at 1*d.* *per* lb. costing from 8*l.* to 9*l.* *per* ton - - - - - - - - - - - -	0	0	2
Eight lbs. of straw at 2*d.* *per* stone - - - -	0	0	1
	£. 0	0	5½

The

The chaff, beyond the expense of boiling, may be considered as entirely profit to the farmer; *2d. per* stone for straw likewise leaves a great profit. Turnips also pay the farmer very well at *¼d. per* stone.

Expense of feeding one milch cow for 200 days, the period upon which the experiment is made:

	£.	*s.*	*d.*
200 days keep of one milch cow, at the rate of 5½*d. per* day - - - - - - - - - - - - -	4	11	8
Attendance - - - - - - - - - - - - - -	2	0	0
Supposed loss on re-sale - - - - - - - - -	2	0	0
	£. 8	11	8

Return made of one milch cow in 200 days milking:

6 quarts *per* day at *2d. per* quart, for 200 days	10	0	0
Calf - - - - - - - - - - - - - - - -	2	0	0
Profit on 20 carts of manure, 1*s.* 6*d.* each -	1	10	0
	13	10	0
Clear gain upon each milch cow	£. 4	18	4

This gives a profit upon the whole stock of 147*l.* 10*s.* The profit of another month may be added before a supply of milk can be had from grass, which will make the balance of profit 167*l.* 18*s.* 4*d.* This profit, though not as large as it ought to have been, had the stock been favourable for the experiment, far exceeds what could be made of the same quantity of food by fattening cattle. Were the two quarts to be added, which on a moderate computation might be expected, the gain would then be 267*l.* 16*s.* 4*d.* The trifling quantity of land, from which the cattle were supported, is a most important consideration. One half of their food is applicable to no other

 purpose,

purpose, and is equally employed in carrying on the system of a corn farm. I have found oil cake of the utmost advantage to my dairy, promoting milk, and contributing greatly to keep the milch cows in condition. The best method of using it is to grind it to a powder, and to mix it in layers and boil it with the chaff: half the quantity in this way answers better than as much more given in the cake, besides the saving of 2*d*. a day on each beast. This I was not aware of on my first trial. The oil cake adds considerably to the quantity and richness of the milk without affecting its flavour. The refuse corn was likewise ground and boiled: it is charged also at 1*d*. *per* pound. I make use of inferior barley to great advantage. A change of food is much to the advantage of the dairy. Potatoes steamed would answer admirably; but near towns they are too expensive.

By repeated trials it was found that 7 quarts of strippings, wine measure, gave a pound of butter, while 8 quarts of a mixture of the whole milk was required to produce the same weight. Contrast this with milk produced from the feeding of grains, 20 quarts of which will scarce afford a pound of butter.

The Agricultural Report of Lancashire, treating on the milk in the neighbourhood of Liverpool and Manchester, states 18 quarts with a hand churn, and 14 or 15 with a horse churn. In a paper published by the Bath Society, 12 quarts are said to give a pound of butter: but whether ale or wine measure is not specified. A friend of mine, who feeds his milch cows principally on hay, finds 16 wine quarts will not yield more than 17 ounces of butter, and this upon repeated trials.

The milch cows, treated according to my new plan, have been in excellent order both seasons, and are allowed to be superior to any in the neighbourhood.

Cole

Cole seed I have found to be the most profitable of all green crops for milk; and it possesses the farther advantage of standing till other green food is ready to supply its place.

To ascertain the benefit and utility of a supply of milk both to the consumer and the public will be best done by comparison.

To prove this let us contrast the price of milk with other articles of prime necessity, and consider how far it affords a greater produce from a less consumption of food.

I cannot here omit observing, at a moment when Great Britain can hope for no farther supply of grain from the Continent, and must look for and depend on her own resources for feeding her population, every mean by which the quantity of victuals can be augmented is an object of great public concern.

Each milch cow yielding 6 quarts of milk *per* day, furnishes in the period of 200 days 2,400 pounds of milk, or 171 stone of 14 pounds, equal to twice her weight, supposing her in a state fit for killing, with a third less food, and at one half less expense. The milk costs 10*l*.; whilst the same weight of butchers meat at 6*d*. *per* pound would amount to 60*l*.

Taking the scale of comparison with bread, we shall find a Winchester bushel of wheat of the usual weight of 4 stone and 4½lb. when manufactured into flour of three sorts yields

Of first flour - - - - -	2st.	9lb.
Of second - - - - - -	0	7lb.
Of third - - - - - - -	0	7lb.
	3	9lb.
Lost by bran, &c. - - - -	0	9½lb.

The

The present cost is 10*s.* 3*d.* 2,400lb. of the three sorts of flour will cost 23*l.* 3*s.* 9*d.* To make it into bread allow 1*s.* *per* bushel, which makes the cost of bread 26*l.* 10*s.* 9*d.* or something more than 2½*d.* *per* lb. exceeding twice the price of the same weight of milk. To furnish 2,400lbs. of bread requires 47 bushels, or the average produce of two acres of wheat.

Three acres of green food supplied 30 milch cows with 2 stone each of green food for 200 days. Two stone of hay each for the same period would have required 75 acres of hay. Chaff can scarcely be considered as of any value beyond the manure it would make, which shews the profit of keeping milch cows in all corn farms.

Certificates of the quantities of milk sold and money received accompany this.

Schoose Farm, April 18, 1806.

I Isaac Kendal, Bailiff to J. C. Curwen, Esq. do certify that the following quantities of milk have been sold from the 1st of October last to the 18th of April 1806.

To Jan. 1, 1806 - - - - - -	16,685
From that date to April 18, 1806	22,027
	38,712

	£.	s.	d.
Cash received for new and skimmed milk -	320	7	5¼
Calves sold - - - - - - - - - - - -	44	0	0
	£. 364	7	5¼

I conceive the estimate of 5½*d.* *per* day to be correct.

200 days

	£.	s.	d.
200 days keep of 30 cows - - - - - - -	137	10	0
Cost of attendance - - - - - - - - - -	60	0	0
Loss upon re-sale - - - - - - - - - -	60	0	0
	£. 257	10	0

Cash received as before	£. 364	7	5½			
600 carts of manure at 1*s.* 6*d.*	45	0	0			
				£.409	7	5½
			Profit	£. 151	17	5½

Experiments on the Growth of White Thorn.

By SAMUEL TAYLOR, *Esq. of Moston, near Manchester.*

From the TRANSACTIONS of the SOCIETY for the ENCOURAGEMENT of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal was presented to tne Author of these Experiments.

EVERY one, I think, will allow that Fences are material objects to be attended to in Agriculture; and also be convinced that there is no plant in this kingdom of which they can so properly be made as the Cratægus Oxyacantha Linnæi, or common White Thorn. In consequence of my being convinced of this, I have been induced to make a few experiments to effect the better propagation of that valuable plant; the result of which, along with specimens of my success, I beg leave to submit to the inspection of the Society.

In

In the year 1801, I had occasion to purchase a quantity of thorns, and finding them very dear, I was determined to try some experiments, in order if possible to raise them at a less expense. I tried to propagate them from cuttings of the branches, but with little or no success. I likewise tried if pieces of the root would grow; and I cut from the thorns which I had purchased, about a dozen of such roots as pleased me, and planted them in a border along with those I had bought. To my great astonishment, not one of them died; and in two years they became as good thorns as the average of those I had purchased. The thorns I purchased were three years old when I got them. In April 1802, I had occasion to move a fence, from which I procured as many roots of thorns as made me upwards of two thousand cuttings, of which I did not lose five in the hundred.

In the spring of 1803, I likewise planted as many cuttings of thorn roots as I could get. In 1804, I did the same; and this year I shall plant many thousands.

I have sent for the inspection of the Society specimens* of the produce of 1802, 1803, and 1804, raised after my method, with the best I could get of those raised from haws in the common way, which generally lie one year in the ground before they vegetate. They are all exactly one, two, and three years old, from the day they were planted.—I was so pleased with my success in raising so valuable an article to the farming interest of this kingdom, at so trifling an expense, (for it is merely that of cutting the roots into lengths and planting them) that I was determined to make it known to the world.

The method of raising the Thorns from roots of the plant, is as follows.

* Preserved in the Society's Repository.

I would

I would advise every farmer to purchase a hundred or a thousand thorns, according to the size of his farm, and plant them in his orchard or garden, and when they have attained the thickness of my three-year-old specimens, which is the size I always prefer for planting in fences, let him take them up and prune the roots in the manner I have pruned the specimen sent, from which he will upon an average get ten or twelve cuttings from each plant, which is as good as thorns of the same thickness; so that it will be easily perceived that in three years he will have a succession of plants fit for use, which he may if he pleases increase ten-fold every time he takes them up.

The spring (say all April) is the best time to plant the cuttings, which must be done in rows half a yard asunder, and about four inches from each other in the row; they ought to be about four inches long, and planted with the top one-fourth of an inch out of the ground, and well fastened; otherwise they will not succeed so well.

The reason why I prefer spring to autumn for planting the roots, is, that were they to be planted in autumn, they would not have got sufficient hold of the ground before the frost set in, which would raise them all from the ground, and, if not entirely destroy the plants, would oblige the farmer to plant them afresh.

I have attached the produce of my three-year-old specimen to the plants it came from, cut in the way I always practise; on the thick end of the root I make two, and on the other end one cut, by which means the proper end to be planted uppermost, which is the thick one, may easily be known.

Although I recommend the roots to be planted in April, yet the farmer may, where he pleases, take up the

the thorns he may want, and put the roots he has pruned off into sand or mould, where they will keep until he has leisure to cut them into proper lengths for planting; he will likewise keep them in the same way, until planted.

The great advantage of my plan is: first, that in case any one has raised from haws, a thorn with remarkably large prickles, of vigorous growth, or possessing any other qualification requisite to make a good fence, he may propagate it far better and sooner, from roots, than any other way. Secondly, in three years he may raise from roots a better plant, than can in six years be raised from haws, aud with double the quantity of roots; my three-year-old specimen would have been half as big again, had I not been obliged to move all my cuttings the second year after they were planted.

It would not be a bad way, in order to get roots, to plant a hedge in any convenient place, and on each side trench the ground two yards wide, and two grafts deep; from which, every two or three years, a large quantity of roots might be obtained, by trenching the ground over again, and cutting away what roots were found, which would all be young and of a proper thickness. I do not like them of a larger size than the specimens sent.

I am at present engaged in several experiments, to endeavour to propagate the thorn from the branches, which, if successful, I will communicate to you; but I am of opinion, that what is now done is sufficient.

On

On the inverted Action of the alburnous Vessels of Trees.

By THOMAS ANDREW KNIGHT, *Esq. F.R.S.*

From the PHILOSOPHICAL TRANSACTIONS.

I HAVE endeavoured to prove, in several Memoirs *, that the fluid by which the various parts (that are annually added to trees, and herbaceous plants whose organization is similar to that of trees) are generated, has previously circulated through their leaves † either in the same, or preceding season, and subsequently descended through their bark; and after having repeated every experiment that occurred to me, from which I suspected an unfavourable result, I am not in possession of a single fact which is not perfectly consistent with the theory I have advanced.

There is, however, one circumstance stated by Hales and Du Hamel, which appears strongly to militate against my hypothesis; and as that circumstance probably induced Hales to deny altogether the existence of circulation in plants, and Du Hamel to speak less decisively in favour of it than he possibly might otherwise have done, I am anxious to reconcile the statements of these great

* In the Phil. Trans. for 1801, 1803, 1804, and 1805, and introduced in the preceding volumes of this work.

† During the circulation of the sap through the leaves, a transparent fluid is emitted, in the night, from pores situated on their edges; and on evaporating this liquid, obtained from very luxuriant plants of the vine, I found a very large residuum to remain, which was similar in external appearance to carbonate of lime. It must, however, have been evidently a very different substance from the very large portion, which the water held in solution. I do not know that this substance has been analyzed, or noticed by any naturalist.

 natu-

naturalists, (which I acknowledge to be perfectly correct,) with my former statements and opinions.

Both Hales and Du Hamel have proved, that when two circular incisions through the bark, round the stem of a tree, are made at a small distance from each other, and when the bark between these incisions is wholly taken away, that portion of the stem which is below the incisions through the bark continues to live, and in some degree to increase in size, though much more slowly than the parts above the incisions. They have also observed that a small elevated ridge (*bourrelet*) is formed round the lower lip of the wound in the bark, which makes some slight advances to meet the bark and wood projected, in much quantity, from the opposite, or upper lip of the wound.

I have endeavoured, in a former Memoir *, to explain the cause why some portion of growth takes place below incisions through the bark, by supposing that a small part of the true sap, descending from the leaves, escapes downwards through the porous substance of the alburnum. Several facts stated by Hales seem favourable to this supposition; and the existence of a power in the alburnum to carry the sap in different directions, is proved in the growth of inverted cuttings of different species of trees †. But I have derived so many advantages, both as a gardener and farmer, (particularly in the management of fruit and forest trees), from the experiments which have been the subject of my former memoirs, that I am confident much public benefit might be derived from an intimate acquaintance with the use and office of the various organs of plants; and thence feel anxious to adduce facts to prove that the conclusions I have drawn

* Phil. Trans. for 1803. † Ibid. for 1804.

are

are not inconsistent with the facts stated by my great predecessors.

It has been acknowledged, I believe, by every naturalist who has written on the subject, (and the fact is indeed too obvious to be controverted), that the matter which enters into the composition of the radicles of germinating seeds existed previously in their cotyledons; and as the radicles increase only in length by parts successively added to their apices, or points most distant from their cotyledons, it follows of necessity that the first motion of the true sap, as this period, is downwards. And as no alburnous tubes exist in the radicles of germinating seeds during the earlier periods of their growth, the sap in its descent must either pass through the bark, or the medulla. But the medulla does not apparently contain any vessels calculated to carry the descending sap; whilst the cortical vessels are, during this period, much distended and full of moisture: and as the medulla certainly does not carry any fluid in stems or branches of more than one year old, it can scarcely be suspected that it, at any period, conveys the whole current of the descending sap.

As the leaves grow, and enter on their office, cortical vessels, in every respect apparently similar to those which descended from the cotyledons, are found to descend from the bases of the leaves; and there appears no reason, with which I am acquainted, to suspect that both do not carry a similar fluid, and that the course of this fluid is, in the first instance, always towards the roots.

The ascending sap, on the contrary, rises wholly through the alburnum and central vessels; for the destruction of a portion of the bark, in a circle round the tree, does not immediately in the slightest degree check the growth of its leaves and branches: but the alburnous

vessels appear, from the experiments I have related in a former paper *, and from those I shall now proceed to relate, to be also capable of an inverted action, when that becomes necessary to preserve the existence of the plant.

As soon as the leaves of the oak were nearly full grown in the last Spring, I selected in several instances two poles of the same age, and springing from the same roots in a coppice, which had been felled about six years preceding; and making two circular incisions at the distance of three inches from each other through the bark of one of the poles on each stool, I destroyed the bark between the incisions, and thus cut off the stem and roots, through the bark. Much growth, as usual, took place above the space from which the bark had been taken off, and very little below it.

Examining the state of the experiment in the succeeding Winter, I found it had not succeeded according to my hopes: for a portion of the alburnum, in almost every instance, was lifeless, and almost dry, to a considerable distance below the space from which the bark had been removed. In one instance the whole of it was, however, perfectly alive; and in this I found the specific gravity of the wood above the decorticated space to be 114, and below it 111; and the wood of the unmutilated pole at the same distance from the ground to be 112, each being weighed as soon as it was detached from the root.

Had the true sap in this instance wholly stagnated above the decorticated space, the specific gravity of the wood there ought to have been, according to the result of former experiments †, comparatively much greater:

* Phil. Trans. for 1804. † Ibid. for 1805.

but

but I do not wish to draw any conclusion from a single experiment; and indeed I see very considerable difficulty in obtaining any very satisfactory or decisive facts from any experiments on plants, in this case, in which the same roots and stems collect and convey the sap during the Spring and Summer, and retain, within themselves, that which is, during the Autumn and Winter, reserved to form new organs of assimilation in the succeeding Spring. In the tuberous-rooted plants, the roots and stems which collect and convey the sap in one season, and those in which it is deposited and reserved for the succeeding season, are perfectly distinct organs; and from one of these, the potatoe, I obtained more interesting and decisive results.

My principal object was to prove that a fluid descends from the leaves and stem to form the tuberous roots of this plant; and that this fluid will in part escape down the alburnous substance of the stem when the continuity of the cortical vessels is interrupted: but I had also another object in view.

Every gardener knows that early varieties of the potatoe never afford either blossoms or seeds; and I attributed this peculiarity to privation of nutriment, owing to the tubers being formed preternaturally early, and thence drawing off that portion of the true sap, which in the ordinary course of nature is employed in the formation and nutrition of blossoms and seeds.

I therefore planted, in the last Spring, some cuttings of a very early variety of the potatoe, which had never been known to blossom, in garden pots, having heaped the mould as high as I could above the level of the pot, and planted the portion of the root nearly at the top of it. When the plants had grown a few inches high, they were secured to strong sticks, which had been fixed erect in the

pots

pots for that purpose, and the mould was then washed away from the base of their stems by a strong current of water. Each plant was now suspended in air, and had no communication with the soil in the pots, except by its fibrous roots, and as these are perfectly distinct organs from the runners which generate and feed the tuberous roots, I could readily prevent the formation of them. Efforts were soon made by every plant to generate runners and tuberous roots; but these were destroyed as soon as they became perceptible. An increased luxuriance of growth now became visible in every plant, numerous blossoms were emitted, and every blossom afforded fruit.

Conceiving, however, that a small part only of the true sap would be expended in the production of blossoms and seeds, I was anxious to discover what use nature would make of that which remained; and I therefore took effectual means to prevent the formation of tubers on any part of the plants, except the extremities of the lateral branches, those being the points most distant from the earth, in which the tubers are naturally deposited. After an ineffective struggle of a few weeks, the plants became perfectly obedient to my wishes, and formed their tubers precisely in the places I had assigned them. Many of the joints of the plants during the experiment became enlarged and turgid; and I am much inclined to believe, that if I had totally prevented the formation of regular tubers, these joints would have acquired an organization capable of retaining life, and of affording plants in the succeeding spring.

I had another variety of the potatoe, which grew with great luxuriance, and afforded many lateral branches; and just at that period, when I had ascertained the first commencing formation of the tubers beneath the soil, I nearly

nearly detached many of these lateral branches from the principal stems, letting them remain suspended by such a portion only of alburnous and cortical fibres and vessels as were sufficient to preserve life. In this position I conceived that if their leaves and stems contained any unemployed true sap, it could not readily find its way to the tuberous roots, its passage being obstructed by the rupture of the vessels, and by gravitation; and I had soon the pleasure to see that, instead of returning down the principal stem into the ground, it remained and formed small tubers at the base of the leaves of the depending branches.

The preceding facts are, I think, sufficient to prove that the fluid, from which the tuberous root of the potatoe, when growing beneath the soil, derives its component matter, exists previously either in the stems or leaves; and that it subsequently descends into the earth: and as the cortical vessels, during every period of the growth of the tuber, are filled with the true sap of the plant, and as these vessels extend into the runners, which carry nutriment to the tuber, and in other instances evidently convey the true sap downwards, there appears little reason to doubt that through these vessels the tuber is naturally fed.

To ascertain, therefore, whether the tubers would continue to be fed when the passage of the true sap down the cortical vessels was interrupted, I removed a portion of bark of the width of five lines, and extending round the stems of several plants of the potatoe, close to the surface of the ground, soon after that period when the tubers were first formed. The plants continued some time in health, and during that period the tubes continued to grow, deriving their nutriment, as I conclude, from the leaves, by an inverted action of the alburnous vessels. The

The tubers, however, by no means attained their natural size, partly owing to the declining health of the plant, and partly to the stagnation of a portion of the true sap above the decorticated space.

The fluid contained in the leaf has not, however, been proved, in any of the preceding experiments, to pass downwards through the decorticated space, and to be subsequently discharged into the bark below it: but I have proved with amputated branches of different species of trees, that the water which their leaves absorb, when immersed in that fluid, will be carried downwards by the alburnum, and conveyed into a portion of bark below the decorticated space; and that the insulated bark will be preserved alive and moist during several days *; and if the moisture absorbed by a leaf can be thus transferred, it appears extremely probable that the true sap will pass through the same channel. This power in the alburnum to carry fluids in different directions probably answers very important purposes in hot climates, where the dews are abundant and the soil very dry; for the moisture the dews afford may thus be conveyed to the extremities of the roots: and Hales has proved that the leaves absorb most when placed in humid air; and that the sap descends, either through the bark or alburnum, during the night.

If the inverted action of the alburnous vessels in the decorticated space be admitted, it is not difficult to explain the cause why some degree of growth takes place below such decorticated spaces on the stems of trees; and why a small portion of bark and wood is generated on the lower lip of the wound. A considerable portion

* This experiment does not succeed till the leaf has attained its full growth and maturity, and the alburnum of the annual shoot its perfect organization.

of

of the descending true sap certainly stagnates above the wound, and of that which escapes into the bark below it, the greater part is probably carried towards, and into, the roots; where it preserves life, and occasions some degree of growth to take place. But a small portion of that fluid will be carried upwards by capillary attraction, between the bark and the alburnum, exclusive of the immediate action of the latter substance, and the whole of this will stagnate the lower lip of the wound; where I conceive it generates the small portion of wood and bark, which Hales and Du Hamel have described.

I should scarcely have thought an account of the preceding experiments worthy of communication, but that many of the conclusions I have drawn in my former memoirs appear, at first view, almost incompatible with the facts stated by Hales and Du Hamel, and that I had one fact to communicate relative to the effects produced by the stagnation of the descending sap of resinous trees, which appeared to lead to important consequences. I have in my possession a piece of a fir-tree, from which a portion of bark, extending round its whole stem, had been taken off several years before the tree was felled; and of this portion of wood one part grew above, and the other below, the decorticated space. Conceiving that, according to the theory I am endeavouring to support, the wood above the decorticated space ought to be much heavier than that below it, owing to the stagnation of the descending sap, I ascertained the specific gravity of both kinds, taking a wedge of each, as nearly of the same form as I could obtain, and I found the difference greatly more than I had anticipated, the specific gravity of the wood above the decorticated space being 0.590, and of that below only 0,491: and having steeped pieces of each, which weighed a hundred grains, during twelve

hours,

hours in water, I found the latter had absorbed 69 grains, and the former only 51.

The increased solidity of the wood above the decorticated space, in this instance, must, I conceive have arisen from the stagnation of the true sap in its descent from the leaves; and therefore in selling firs, or other resinous trees, considerable advantages may be expected from stripping off a portion of their bark all round their trunks, close to the surface of the ground, about the end of May or beginning of June, in the summer preceding the autumn in which they are to be felled. For much of the resinous matter contained in the roots of these is probably carried up by the ascending sap in the spring, and the return of a large portion of this matter to the roots would probably be prevented *: the timber I have, however, very little doubt would be much improved by standing a second year, and being then felled in the autumn; but some loss would be sustained owing to the slow growth of the trees in the second summer. The alburnum of other trees might probably be rendered more solid and durable by the same process: but the descending sap of these, being of a more fluid consistence than that of the resinous tribe, would escape through the decorticated space into the roots in much larger quantity.

It may be suspected that the increased solidity of the wood in the fir-tree I have described was confined to the part adjacent to the decorticated space; but it has been

* The roots of trees, though of much less diameter than their trunks and branches, probably contain much more alburnum and bark, because they are wholly without heart wood, and extend to a much greater length than the branches; and thence it may be suspected that when fir-trees are felled, their roots contain at least as much resinous matter, in a fluid moveable state, as their trunks and branches; though not so much as is contained, in a concrete state, in the heart wood of those.

long

long known to gardeners, that taking off a portion of bark round the branch of a fruit-tree occasions the production of much blossom on every part of that branch in the succeeding season. The blossom in this case probably owes its existence to a stagnation of the true sap extending to the extremities of the branch above the decorticated space; and it may therefore be expected that the alburnous matter of the trunk and branches of a resinous tree will be rendered more solid by a similar operation.

I send you * two specimens of the fir-wood I have described, the one having been taken off above, and the other below, the decorticated space. The bark of the latter kind scarcely exceeded one-tenth of a line in thickness; the cause of which I propose to endeavour to explain in a future communication relative to the reproduction of bark.

List of Patents obtained in France for Inventions, &c.

(To be continued occasionally.)

THE French Government perceiving no doubt the great advantage which the Arts and Manufactures of England have derived from the encouragement bestowed on ingenious industry, by granting Patents for new Inventions and Discoveries, have lately adopted that practice in its full extent. Not doubting but the curiosity of many of our readers will be gratified by an occasional account of them, and that many useful hints may be drawn from them, we have procured the following list of those recently granted, and shall continue to publish those in future. More particular accounts have been inserted of many of them in several of our preceding volumes.

* Sir Joseph Banks.

In the Year 1805.

Messrs. *Despiaux*, for a loom for weaving cloth and stuffs.

M. *Desrockes*, for a new kind of light carriages, under the denomination of *Télégraphs.*

Messrs. *Singer* and Co. for a kiln for burning tiles and bricks.

M. *Bandour*, for an economical oven, to be heated without putting the fuel into the oven.

Messrs. *Jobert*, *Lucas*, and Co. for the invention of a cloth of wool and mixed wools of France, in imitation of cachemire.

M. *Curaudeau*, for a method of constructing furnaces, chimnies, stoves, &c.

The same, for a process by which he makes roach alum.

M. *Didot*, for a method of casting printing-types.

Messrs. *Farreau* and *Thiébaut*, for a hand-loom, or continued rotation.

M. *Brugnières*, for an improved distilling apparatus.

M. *Wathier*, for a machine for raising the nap on woollen cloths.

In the Year 1806.

Messrs. *Cannes* and *Lanaspeze*, for a machine to prevent chimnies from smoking.

M. *M. J. B. Cellier*, for an indestructible and incorruptible ink.

M. *Curaudau*, for an improvement in his pyrotechnic constructions, for which he had obtained a former patent.

Messrs. *Guillaume* and *Lemarre*, for the invention of a method of producing prototype editions.

M. *Janin*, for the invention of processes for gilding on wood.

M. *James*

M. *James Douglas* *, for improvements, changes, and additions to the machines for spinning wool, for which he had obtained a former patent.

Messrs. *Montassier* and *Reine*, for the composition of pitch and tar.

M. *André Lorraine*, for the invention of a process in the fabrication of candles, perfumed wax-tapers, white and coloured.

Messrs. *Terneaux*, brothers, for a new species of stuffs, in imitation of Spanish wool.

M. *Lange*, for improvements and additions to his lamps, having a current of air, for which he had obtained a former patent.

M. *Stickwier*, for the invention of an easy method of rectifying alcohol, at a little expense.

Messrs. *Benoist*, *Piniaux*, son, and *Guillons*, for new methods, processes, and machines, for clarifying and perfectly refining sugar.

M. *Georges*, for an improvement in the machine for carding wool, for which he had obtained a former patent.

M. *Caron*, for the invention of a new process in, and a frame for, the composition of peruques.

M. *Durivoir*, for the construction of several new carriages, and additions to them.

Messrs. *Girard*, brothers, for improvements and additions to their hydrostatic and mechanical lamps and globes of crystal.

M. *Marmont*, for the invention of a mirror, which he calls *Odontotechnic*.

M. *Adam*, for improvements and additions to the process which he employs to draw from wine all the alcohol that it contains.

* This perſon is a native of Great Britain, and had obtained ſeveral patents in England previous to his ſettling in France.

M. *Delatour*

M. *Delatour*, for an addition to the method by which he makes boats to advance against the stream of rivers without the help of any human power.

M. *Géniez*, for the invention of cylinders, upon which are applied, by means of a resinous cement, moveable characters for the printing of linens, paper, music, typographical objects, &c.

Messrs. *Callias*, brothers, for an improvement and addition to the method of carbonizing turf.

M. *Albert*, for improvements, changes, and additions to his wheel of a double power.

M. *Faux*, for improvements and changes in his machine for opening and carding wool.

Messrs. *Goin* and *De Marperger*, for their invention of an hydraulic machine for raising weights.

M. *Desquinemare*, for the invention of a machine which he calls *Panémore Anémomètre.*

M. *De Marguerie*, for an economical fuel.

M. *Poulleau*, for the invention of a musical instrument, which he calls *Orchestrino.*

M. and *A. Dubouchet*, for the invention of a new method of managing boats.

M. *De Lorme*, for the invention of a velvet embroidery.

M. *Lavilleneuve*, for the imitation of Wedgewood Porcelaine, in all kinds of subjects. Made in metal, and varnished.

Messrs. *Christ* and *Potter*, for a new method of preparing turf.

M. *Demoutier*, for a method by means of which water may be drawn from a great depth, and raised to the highest degree of elevation.

M. *Caron*, for an addition and improvement in his frame for making peruques, for which he had a former patent.

M. *Lavil-*

M. *Lavilleneuve*, for the invention of a method of gilding with oil, in burnished gold, all sorts of objects made in varnished metal.

M. *White*, for additions and improvements in the system of preparing materials for spinning, and of spinning them, for which he has obtained a former patent.

M. *Thilorier*, for an addition to and improvement in his stoves, which he calls *Fumivores*, and for which he obtained a former patent.

M. *Japy*, for the invention of a machine for drawing steel, brass, and iron wire.

M. *Berard*, for the invention of a distilling apparatus.

Messrs. *Oyon* and Co. for an improvement in the method of preparing turf, for which he obtained a former patent.

M. *Ollivier*, for a new-invented stove, which he has entitled a *Calorifere*.

M. *Chanary*, for the invention of a method for improving the distillation of brandy and other spirits.

M. *Gensoul*, for the invention of a machine by which the necessary heat is applied to the spinning of cotton, by means of steam.

M. *Barre*, for an improvement in the method of proving brandy, and other spirits.

Messrs. *Jourdan*, father and son, for an improvement in the frame for making the ground of silk lace, in imitation of the English; and for which they had obtained a former patent.

M. *Harel*, for the invention of an economical chimney, which is both inoffensive and agreeable.

M. *Pigarros*, for a new method of suspending carriages.

M. *Brochet*, for a new reverberating furnace, which is both economical and portable.

M. *Chabane*,

M. *Chabane*, for an improvement and addition to his carriages called *Vélociferes*, for which he obtained a former patent.

M. *Bellemère*, for a machine united by a double lever and balance, for making ribbed stockings, like the English.

M. *Lavocat*, for a new kind of wind-mill.

M. *Menault*, for a new fire-mill * for grinding corn.

Madame *Adhémar*, for a machine which she calls *Force Lumière*.

M. *Pouchet*, for an improvement in the system of rolling.

M. *Cartier*, for doubling the power of horses, gigs, and chariots, by adapting pulleys to them.

M. *Jacquard*, for a thread-loom.

M. *Berard*, for additions and improvements in the distilling apparatus for which he obtained a former patent.

M. *Bruguiere*, for alterations in the distilling apparatus for which he obtained a former patent.

M. *Biemont*, for a machine for spinning wool.

Messrs. *Singer* and Co. for additions and improvements in his oven formed of tiles, lime, &c. for which he has obtained a former patent.

M. *Bourdeux*, for a portable saw.

M. *Meunier*, for a new method of fabricating ribbons, shawls, mohairs, velvets, &c. (having the shag or plush ornaments woven in); and all materials spun with gold and silver, in all lengths, shades, and patterns, in one or several colours.

M. *Rebout*, for an apparatus for distilling brandy.

M. *Bernavon*, for improving the method of applying the heat from a smith's hearth to the purposes of distillation and evaporation.

* Most likely a steam engine.

Report

Report on the different Methods of extracting with Advantage the Salt of Soda from Sea-Salt.

By LELIEVRE, PELLETIER, D'ARCET *and* GIROUD; *extracted by* J. C. DELAMETHERIE.

(Continued from Page 240.)

THIS experiment was repeated some days afterwards in the same furnace, and with the same quantity of matter, but with a sulphate of soda taken from the manufactory at Payen, which we had carefully calcined. The same precautions were taken as before, and the operation was terminated nearly within the same time.

A sample of each of these substances was taken; they were caustic, and crumbled with facility.

Five pounds of this rough soda were exposed to the air for twenty days; it there slacked and fell into powder, and in that state, its weight was so much increased, that the five pounds weighed eight. This augmentation was owing to the water and carbonic acid, which the caustic soda had attracted from the atmosphere. It must be observed, that while the soda thus slacked, sulphuretted hepatic gas and heat were disengaged. We shall see by what follows, that the residue is a true pyrophorus.

The Products of M. ALBAN'S *Rough Soda.*

	lb.	oz.
Rough soda made with sulphate of soda and iron - - - - - - - - - - - - - - -	100	0
The leys evaporated, yielded crystallized soda	71	4
Soda, dry and pulverulent, partly caustic and partly aerated, containing a little iron and charcoal - - - - - - - - - - - - - -	22	11

Residue

Residue of the Leys.

Sulphuret of iron, united with a little charcoal dried, 86 pounds six ounces.

This process is absolutely the same as that proposed to government in 1777 by Malherbe, then a Benedictine friar, and upon which Macquer and Montigny made a favourable report on the 13th of March, 1778.

There was likewise a second report made to government equally favourable, on 16th of August, 1779, by Grignon. This experiment was made at Croisic, by Athenas in junction with Malherbe, on several thousand weight of matter; but it was with the sulphuret of iron that it was executed. Thus the priority of the decomposition of sea-salt, and of the extraction of its base, is decidedly in favour of these philosophers; and thus all these processes are the necessary consequences of their labours, which were already known several years before.

Process of Messrs. Malherbe and Athenas, by the Agency of Iron.

The process of Malherbe, which was communicated to us by Jourdan, proprietor of the Glass-house at Muntzhal, and confirmed by Malherbe himself, is very simple. "He says, take such a quantity as is requisite of sulphate of soda, add $\frac{1}{10}$ of charcoal in powder, and $\frac{1}{3}$ of iron, or old iron, it matters not which; melt the whole together; when the mass is melted and run off, it hardens as it cools; but it soon crumbles in the air: the ley made from it is greenish, owing either to a little iron or the charcoal which the caustic alkali holds in solution; however, evaporate the solution and crystallize your salt, or, what is still better, evaporate it to dryness, calcine it to a slight

a slight incandescence, add you will have a mineral alkali, possessing all the properties you require."

We have said that this process of Malherbè was authentically stated in the year 1778, and now that it is used by Alban, in his manufactory at Javelle, it will no doubt succeed.

Process of Malherbe and Athenas, by the Agency of Sulphate of Iron.

"Take, says Athenas, 14 parts of sulphate of iron, which has been calcined at a mild heat, to redness, in a reverberating furnace, add ten parts of calcined sea-salt, keep up the fire until the muriatic acid is entirely disengaged; then the sea-salt being converted into sulphate of soda, and the mass hot and well melted, charcoal must be added, and the whole mass fused. The oxyd of iron returns to a metallic state, and recombines with the sulphur; the mass which crystallizes internally, as it cools, in brilliant and sparry leaves, must be taken out of the furnace: this mass forcibly attracts the moisture of the air, and effloresces, owing either to the particles of pyrites that are disseminated in it, or the alkali that it contains in a caustic state, and which consequently attracts water with avidity.

"The whole is dissolved in order to separate this salt; and the residue is a paste of a greenish blue, which approaches very nearly to the colour of Prussian blue. It has the viscosity of the lees of wine, it requires a great number of washings to deprive it entirely of all the alkaline matter: if exposed to a mild heat, it heats and inflames in the same manner as a mixture of sulphur, iron, and water. The sulphate of iron which results from it, is in the state of the incrystallizable mother waters, owing to the inflammation produced by the rapidity of the decom-

 position.

position. The calcined ferruginous residue yields the English red brown of commerce, which compensates for part of the expense."

The use of sulphate of iron appears to have owed its origin to the difficulties which Athenas met with in making sulphuric acid without saltpetre, who, in order to make it cheap, and to dispose of it, was tempted to substitute martial vitriol. He adopted this method more willingly, because the sulphurous turf, and the vitriolic earth in the environs of Laon, Beauvais, Soissons, St. Quentin, and La Ferté Milon, &c. yield this sulphate in abundance; they are so plentiful, that the hundred weight of this ore cost at that time but four shillings, which would produce 30 pounds of sulphate of iron; and by operating in Bretagne, because of the great market for sea-salt, this vitriol had been sold on the spot at the price of seven livres the quintal, but his means would not permit him to make these establishments.

Before we proceed any farther on this subject, we should call to mind the labours of Lorgna on the native mineral alkali, and on the decomposition of sea-salt, published in the Journal de Physique for the year 1786; we there see that he has decomposed sea salt by martial vitriol and alum, and that he has made vitriol of soda, by the simple mixture of martial vitriol with common salt, merely by moistening it with water, and by the help of agitation and a gentle heat. We may farther observe, that one of his friends had decomposed it by the same process, solely by the help of the moisture resulting from the water of crystallization: these experiments were made since the work of Messrs. Athenas and Malherbe, but it is eight years since M. Lorgna published it in the above very widely-circulated journal.

As,

As, in the decomposition of sea-salt to convert it into sulphate of soda, the method of substituting martial vitriol or sulphate of iron for sulphuric acid, has appeared to us of high importance, we shall also describe an experiment that was made at Javelle.

"Into the same reverberating furnace that was before used, 400 pounds of martial vitriol was introduced with 160 pounds of sea-salt: the furnace had been already heated in the morning; from the time that it was charged, it was kept always red hot, and the fire was augmented by degrees: the disengagement of muriatic acid was considerable; however, it was not until it had sustained the fire for seven hours, that the muriatic vapours sensibly diminished, and that the sea-salt was converted into sulphate of soda; then 43 pounds of charcoal in powder was added by degrees, and at three different times, at intervals of half an hour each: the mass melted well, and the sulphate of soda alkalised with facility. We thus obtained unrefined soda, mixed with iron, similar to that which we had before produced in the same furnace, the process by the iron being executed as before. The produce of this operation was 228 pounds of rough soda, which contains,

	lb.	oz.
Salt of soda dried, partly caustic and partly aërated - - - - - - - - - - - - - -	23	8
Undecomposed sea-salt - - - - - - - -	12	0
Residue after the lixivation, or sulphuret of iron united to a small portion of charcoal - -	62	0

There is, therefore, no doubt as to the excellence of this process; the abundance of martial vitriol which may be furnished from the quantities of turf in the department of Aisne, and in the lands that are watered by the

Somme,

Somme, these near Nantz, besides the considerable mines of pyritous coals, which are near Alais, and in short, in many other places, where it may be more or less easily extracted, and is marketable, will be a certain resource, to supply France with as much soda as her wants may render necessary.

Athenas attempted also to extract soda from muriate of soda, by means of copper and zinc, and, he says, he has succeeded; zinc in particular is very proper for this decomposition. "It is sufficient," he says, "to steep a sheet of this demi-metal in a solution of sea salt, for twelve hours, and afterwards to expose it to the air for another twelve hours, until it is covered with a saline efflorescence." But as in this place it is less necessary to occupy ourselves in matters of science, and processes that relate to the progress of chemistry, than on objects of immediate utility, and more ready means to supply our immediate wants, we shall content ourselves with naming them: zinc being besides a demi-metal, very scarce and dear, and coming from foreign countries, obliged us to renounce it intirely. If we could find at home a plentiful mine, which would serve for this decomposition in its original state, and without farther working, then zinc or its ore would become a local agent.

But there is still another important fact, for which we are indebted to Athenas; which is, the possibility of substituting certain species of iron ore, and perhaps the major part, for old iron, to effect the same alkalisation. It was this method that he attempted, and with success, from the beginning, and even before he determined to make use of sulphate of iron, with a kind of hematite iron ore, which is very common in Bretagne, and is procured from the forges of Lanouée and Vaublanc: he makes

makes this ore red hot, and extinguishes it in water, which renders it very friable and attractable by the magnet *. He pounds it, and mixes it with a sufficient quantity of charcoal, and with an equal weight of dried sulphate of soda: the rest of the process is conducted and executed as with iron, and is not more difficult.

With the same liberality M. Daguin has communicated the supplies that may be drawn from the great and numberless turf lands in the departments of La Vendée, and La Loire *inferieure*. This turf, by simple incineration, furnishes such a quantity of sulphate of soda, that there are some turf-lands, such as that of Monton, below Nantes, of which the ashes yield one fourth of their weight of this salt. In 1792, he composed from the ley of these ashes 200,000 weight of sulphate of soda, and he has written to inform us that by collecting all the ashes produced from this country and its environs, 500,000 pounds of this salt, might easily be manufactured annually. This is a great supply, and is by no means to be neglected.

It is however to be observed, as M. Athenas advises, that it would be wrong to make use of the turf from the departments of Bretagne, with a view of establishing a large manufactory to burn it only. Wood is very scarce in that country, and although turf is not dear, yet most of the inhabitants of Croisic and its vicinity commonly use fuel made from the dung of animals, kneaded with their litter, and dried in the sun, a custom which has been always practised by the inhabitants of Egypt. Those of

* It is probably only the true hematite iron ore that is attractable by the magnet, even when calcined. However that may be, we have repeated this process with sparry ore; and we have likewise decomposed the sulphate of soda, and have obtained carbonate of soda crystallized.

Frise

Frise have mixed their turf with clay ever since the time of Pliny, and in several cantons in Flanders they knead it in the Summer with the rubbish and dust of pit coal, which they dry in the sun before the houses, and preserve for winter use.

But it would be well to collect in the houses, in case of a scarcity, all the ashes from the fire places, to wash them, and afterwards to extract from them the salt for this purpose.

There is another process which has been long known in England, and which M. Arthur was the first to execute in Paris. It consists in decomposing the muriate of soda by lead. But as M. Arthur's object was to prepare the superb yellow of lead, or mineral yellow, for his colours, he neglected the soda that resulted from this operation.

It is under those two points of view that this process has been taken up by Messrs. Chaptal and Berard, and for which they have made an establishment near Montpellier; and as their method is very simple, is executed in the large way, and is described with simplicity, we shall transcribe it entire.

Process of Chaptal and Berard, for decomposing Sea Salt, or Muriate of Soda, and extracting the Soda from it.

"Take four quintals of litharge well sifted; distribute it, in equal portions, into four large glazed earthen vessels.

"Dissolve, in another place, a quintal of sea-salt in about four quintals of water.

"Pour into each of the four earthen vessels a quarter of this solution of sea-salt, in order to form a paste of a slight consistence. Leave the whole at rest for some hours; and, when you perceive that the surface begins to

to whiten, it must be stirred with a strong wooden spatula. Without that the paste would become very hard, and a great part of the sea-salt would escape decomposition.

" It must be stirred continually as it thickens, and should be diluted with fresh quantities of the solution of sea-salt, so as to keep it always of the same degree of consistency. If there be not enough of the solution, water only may be used towards the end of the operation.

" In this manner the decomposition is effected within twenty-four hours, and the result then is an homogeneous paste, very white, without lumps, presenting a mass much more considerable than that of the litharge employed.

" It is best to leave this paste in the vessels, for another four-and-twenty hours, and to stir it from time to time, that the decomposition may be perfectly effected.

" In this state the soda is caustic, and imbibes the muriate of lead. In order to separate this soda, it is only necessary to wash it properly.

" For that purpose, dilute the paste with a sufficient quantity of boiling-water, pouring in a little at a time, and shaking the mixture continually; for without that the paste becomes lumpy, and very difficult to wash.

" Separate afterwards, by decanting it, the clear solution of soda, and disengage the remainder of this alkali from the sediment by filtration, and by expression in a linen cloth.

" The soda is obtained dry, by evaporating the liquor in iron vessels. By this process 75 pounds of soda is procured, which is much more pure than the best soda of commerce, although mixed with a certain quantity of muriate of lead, and sometimes with a little common salt, which may be separated from it by subsequent operations.

"This soda, which is very caustic, absorbs carbonic acid in the air, and increases in weight.

"*Products of this Operation in Muriate of Lead.*

"1. This muriate calcined produces a yellow colour, solid and brilliant, and may be employed successfully with oil.

"2. If sulphuric acid, weakened to 20 or 25 degrees of the aerometer, be poured upon the muriate of lead, it immediately appears of a dazzling white; the mass diminishes considerably in size; and there results a sulphate of lead, of an extreme division and fineness. This salt is washed afresh in a great deal of water. It is mixed with the greatest care, in mills similar to those used in Holland for making cerus. By this method it becomes of a proper consistency. It is afterwards put into porous crucibles; which are placed upon stages, to facilitate the exsiccation.

"This white-lead might serve as a substitute in commerce for that of Holland. It does not become yellow with oil; and it differs from that of commerce only by being lighter, and consequently spreads less easily over the body to be covered with it.

"This white-lead might be employed in painting; but the artist who would use it to cover wainscots, doors, or windows, will find that it has not so strong a body as that of Holland.

"If the sulphate of lead be decomposed by a solution of alkali, the oxyd that is precipitated is of a stronger consistency than the sulphate itself, which makes it approach more to the nature of the white-lead of Holland; but in this state oils will turn it rather yellow.

"3. The muriate of lead may be decomposed by means of carbon, and all the lead contained in the litharge would then

then take a metallic form. This decomposition may be effected in several ways.

" A. The muriate thrown upon lighted coals becomes of a yellow approaching to red, and is reduced to lead.

" B. When dried, and well mixed with one-fourth of its weight of pounded charcoal, and exposed to the fire in iron vessels made red-hot, it yields about 80 pounds of lead to the $\frac{0}{0}$.

" When dried, and mixed with the lees of wine or tartar, and treated as above, it furnishes the same quantity of lead. By this last process, besides the lead, a certain quantity of pearl-ashes are obtained, mixed with a little salt. This new product diminishes the expense of the operation."

They are aware that this process cannot be generally adopted, owing to the price of lead and litharge, which would not fail to rise as it became more difficult to procure, for that which commerce supplies would never be sufficient for so considerable a demand ; but it is no less true that this process when employed with the view of making the white or yellow of lead, would be very practicable in the neighbourhood of lead mines, and especially near large glass works, where, according to the greater or less quantity of lead that the soda absorbs, it becomes in melting very favourable to vitrification, and will even add to the beauty of the crystal.

Process of Carny.

Carny likewise has remitted to us a memoir containing divers methods of decomposing muriate of soda.

This method consists " in slacking quick-lime in water, and afterwards adding to it a saturated solution of sea-salt ; it is made into a paste which is exposed in a low damp place, where the air does not circulate too freely.

 The

The surface of this mixture becomes covered with an efflorescence of carbonate of soda, which is renewed repeatedly; and when at last the lime is exhausted, it may be calcined afresh, and the same operation successively repeated."

We think that this process may be executed, but only in situations equally productive of salt, of lime-stone, and fuel proper for performing the calcination. As for the rest, this method is simple, and it is with reason that the author stiles it natural. We think that the oxyds of iron might be joined with it, such as are found in different states in earths and stones; thus the ordinary bricks would be an excellent material.

It actually happens that in new buildings, in vaults, which are built with cement, the joinings of the stones are often covered with these efflorescenses of carbonate of soda.

Proust observed several years since an efflorescence on the surface of the slates, with which the cellars at Angers are built. Lorgna had also observed the same thing in 1782, as he passed some subterraneous fortifications at Veronne. Pelletier has related, that eighteen months since he collected some from a brick wall, which formed a part of the military hospital at Arras. Desyeux and Parmentier found an abundant efflorescence on the walls of the vaults and low places of the new buildings at Dieppe, Fecamp, and Havre.

In short, the observation of a similar fact, and which confirms what we have already said, has given rise to a memoir which has been addressed to us by Messrs. Lucas, Long-champ, and Cizotz, and it is from this observation made by chance, that they propose a mixture of lime, sand, and a saturated solution of muriate of soda, the whole tempered to the consistence of mortar, with which they

they plaster the walls of vaults, having a proper circulation of air to establish a manufactory of soda.

To this process Carny has added another with the oxyd of red lead; it is as follows:

"Take 50 pounds of the oxyd of red lead and 40 pounds of sea-salt; put the whole into an iron vessel placed upon a furnace. Stir the mixture as the salt decrepitates; when the decrepitation has ceased, pour a little water upon it. Stir it alternately; the matter will swell and become pasty; continue to mix it and pour water upon it, until the oxyd is white in all its parts, and the water covers the mass about the depth of an inch. Then extinguish the fire; pour the mixture into a leaden cauldron, containing about 100 pounds of hot water, stir it again; then leave it to deposit for ten minutes, draw off the clear liquor, and evaporate it to a pellicle in a second cauldron: when at from 34 to 36 degrees, pour it into a third cauldron, and leave it covered over with a woollen cloth for the space of three or four days. During this time, a great part of the muriate of soda which has escaped decomposition, crystallizes; but, as it still remains in the liquor, as well as the oxid of lead with the free soda, evaporate it to dryness, and you will obtain a caustic soda holding a little oxyd of lead in solution; separate it, and leave the liquor exposed to the air; the carbonic acid that unites with it, precipitates the lead in a white and crystalline form; it is certain that there is no lead remaining, when, by means of an acid, no more precipitate can be obtained.

"The residue contains: 1. Muriate of soda: 2. muriate of lead: 3. white oxyd and not combined: 4. plombate of lead: 5, and lastly, carbonate of soda, or aerated soda. Repeated washing carries off all these salts with facility, and nothing remains but white oxyd and muriate of

of lead. This is easily reduced with oil; or else it takes a fine yellow colour; when treated only by melting, it makes the finest yellow of lead."

It is to be observed, that this is the same process both as to the materials and the results, as that of Chaptal and Berard, which we have related above: it is nearly as simple, yet differently conducted in the whole of the operation; and this detail illustrates the process and facilitates its success. As for the rest, Carny, although an enlightened and impartial man, has judged this process more severely than we do; for we admit of circumstances that he does not.

TO BE CONCLUDED IN OUR NEXT.

List of Patents for Inventions, &c.

(Continued from Page 240.)

WILLIAM HANCE, of Tooley-street, in the parish of St. Olave, Southwark, and county of Surrey, Hatter; for a method of rendering water-proof, beaver and other hats. Dated January 29, 1807.

BENJAMIN SOUTHCOMBE, of Brick-lane, in the parish of St. Luke, in the county of Middlesex, Tin-plate-worker; for a method of making flexible or malleable metallic plates into convex or concave forms or hollow shapes. Dated January 29, 1807.

RICHARD FRIEND, of the Broad-way, St. Thomas's, in the Borough of Southwark, and county of Surrey, Gun-carriage-maker; for improvements in the making and working gun and carronade carriages. Dated January 29, 1807.

SIMON ORGILL, of the town and county of the town of Nottingham, Framesmith; for certain stops for working

ing bolt-wheels affixed to the machine attached to the common warp-lace-frame to give motion to the said machine, and also a rotary spindle, projections, and levers, to be affixed to the said frame itself, to give motion to the said frame for the purpose of manufacturing by a more simple, certain, and expeditious method, lace or net work of various figures and qualities, with silk, cotton, worsted, or other materials, produced from animal, vegetable, or mineral substances.
Dated February 3, 1807.

RICHARD LORENTZ, of Great Portland-street, in the county of Middlesex, Esq. for certain machines or instruments, one of which will produce instantaneous light, and the other instantaneous fire; communicated by foreigners residing abroad. Dated February 5, 1807.

JAMES ESSEX, of the town of Northampton, Woolstapler and Grocer; for a method of making or manufacturing dyed, botted, or felted wool, into mats, rugs, carpets, &c. of various colours, figures, patterns, and sizes, for carriages, halls, parlours, hearths, and sundry other purposes. Dated February 5, 1807.

JAMES SPERSHOTT, of Shelton, in the county of Stafford, Clay-merchant; for an improvement in the manufacture of earthenware. Dated February 7, 1807.

JOHN DAY, of Camberwell-green, in the parish of St. Mary Lambeth, Stone-mason; for an engine for the purpose of loading and unloading vessels, and also for raising large anchors and other immense weights to any height required. Dated February 12, 1807.

CHARLES EARL STANHOPE, for improvements respecting the form, construction, and manner of building and fitting out ships and vessels for the purpose of navigation, and especially for counteracting or diminishing the danger of that most mischievous invention for destroying ships

ships and vessels, known by the name or appellation of submarine bombs, carcasses, or explosions *. Dated February 16, 1807.

James Winter, of Stoke under Hamdon, in the county of Somerset, Glove-manufacturer; for a machine for sewing and pointing leather gloves with neatness and strength, much superior to that which is effected by manual labour. Dated February 20, 1807.

Andrew Kauffman, of the parish of St. Leonard Shoreditch, in the county of Middlesex, Musical-instrument-maker; for improvements in the construction of the flageolette or English flute. Dated February 20, 1807.

Archibald Thomson, of the parish of St. John, in the city of Westminster, and county of Middlesex, engineer; for improvements (by the application of known principles) upon certain parts of mill-spinning for spinning of wool or cotton. Dated February 20, 1807.

Isaac Sanford, of the city of Gloucester, Civil Engineer, and Stephen Price, of Stroud, in the county of Gloucester, Civil Engineer; for an improvement or method to raise a nap or pile on woollen, cotton, and all other cloth which may require a nap or pile, as a substitute for teasels or cards. Dated February 20, 1807.

Frederic Albert Winsor, of Pall Mall, in the county of Middlesex, Gentleman; for an improved oven, stove, furnace, or apparatus for the extracting of inflammable air or gas and oil-tar, acetous and ammonial liquors, from different kinds of fuel, for reducing such fuel into coke and charcoal, and for completely purifying such inflammable air or gas of its odour during a state of combustion. Dated February 20, 1807.

* Described in the fifteenth volume of the first series of this work, page 385.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LIX. SECOND SERIES. April 1807.

Specification of the Patent granted to HENRY FOURDRINIER, *of Sherborne-lane, in the City of London, Stationer and Paper-maker; for a Method of making a Machine for manufacturing Paper of an indefinite Length, laid and wove, with separated Moulds.*

Dated July 24, 1806.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Henry Fourdrinier do hereby declare that my * said invention, and the manner in which the same is to be carried into effect and practice, are described in manner following; that is to say: My said machine, and the parts thereof, or therewith to be used, do consist of the following particulars, namely:

First. The moulds; which are similar to those commonly used, excepting that the same are so constructed

* By the list of patents, inserted in vol. IX, p. 240, this and the following invention appears to have been communicated to the Patentee by a foreigner residing abroad.

as that by the thinness of the framing, or extreme part, on each of two opposite sides, any determinate number of the said moulds are capable of being applied with the said sides successively in contact, so as to form one long mould, upon which paper can and may be made, in like manner as if the whole length or series had consisted of one single mould; and likewise, that instead of the deckle being applied to each mould, as is usually practised, there is an edge bar, joined by hinges to each of those sides of the said moulds which are not intended to be so applied to each other. And the said bar is capable of being raised so as to stand perpendicularly with regard to the surface of the mould to which it belongs, and to perform the office of the deckle, by preventing the paper, stuff, or material, from flowing beyond the side edges; and the said edge bar is, by weights, springs, or other fit and sufficient obvious means, made to assume the perpendicular position, excepting when in the course of work it is needful that it should be depressed or turned back.

Secondly. A principal part of my said engine is by me called the platform, and doth consist of a well-framed piece of workmanship, of metal, or other fit material, upon which the moulds are to be supported during the time of work, in such a manner as that the said moulds shall be at liberty to slide along in one direction, backwards or forwards, in successive contact with each other, as before described, but shall not be allowed to deviate in any other direction. And for these purposes the principal parts of the said platform are two straight or right-lined parallel ways or slides, or rails, by which the outer edges or slides of the said moulds are supported. Or otherwise, I do make the said ways to consist of a number of friction rollers; the upper surfaces of which

are

are all disposed in the same plane, and their axes are all at right angles to the line of direction; and in any or every case I do, either by a raised part along the outside of the said ways, or a flanch part at the outer end of each roller, or certain projecting parts beneath each mould, prevent any side deviation in the course of the said moulds along the platform. And I do support the said platform in such a position as that the said moulds shall be and continue horizontal, or nearly so, while resting or moving thereon. The said platform is supported at one end or extremity thereof by chains, or in any other fit manner that shall allow the same to be agitated horizontally, or in its own plane; and the other end thereof is supported upon a pivot or upright cylindrical piece or pin, which is inserted in a hole in the platform, and is made to describe a small horizontal circle during the time of work, and does by that means give the requisite agitation to the platform, and to the moulds which may be placed thereon. The nature and structure of the said support may be easily apprehended, from the consideration that it operates like a handle or crank piece, proceeding from an upright axis, and having its arm adjustable as to its length; and the same may be made in a variety of forms, which are so well known to mechanical operators, that it is altogether needless to describe the same. Or otherwise I do produce the said agitation in a circle; or, if need be, in a back and forward, or any other horizontal directions, by eccentric pieces or grooves of that kind or description which is known by the name of snail-work, or by means of any of the other well-known methods of producing the effect here pointed out or described.

Thirdly. I do fix, place, or dispose above the said platform, and near the end last described, a vessel, contain-

ing the paper, stuff, or material in a state fit and ready to be made into sheets of paper; and the situation of the said vessel is such as to allow the moulds to be successively introduced in their places upon the platform behind each other. On one side of the said vessel there is a trough, which receives the paper stuff therefrom through holes, each provided with one or more registers or shuts of any form or kind, adapted to admit or regulate, or limit, or stop, the supply of the said stuff, which is kept agitated in the said trough by the revolution of a small polygonal piece called a *hog*, or by any other fit means, while it passes or flows to the outer edge of the said trough over which the said stuff flows, and falls in due quantity upon the moulds beneath.

Fourthly. Upon and near the other extremity of the platform which is most remote from the place of agitation, I place and support a cylinder, having its axis parallel to the surface of the moulds, and in a plane at right angles to their course; but the said axis is at liberty, by the nature of its support, to approach to, or recede from, the platform through a limited space, and also to tilt a little at either end; and both which conditions are easily obtained by causing the extremities of the said axis to pass through long holes in its supporters, or by other well known means. The said cylinder is supported by, and connected with, the platform, so that the agitation does not alter the relative situations of the cylinder and the platform and the moulds which shall or may be placed thereon; and the said cylinder hath a tendency downwards, by virtue of its own weight, and likewise of the action of weights or springs, which may be applied to the extremities of its axis. An endless web of felting is passed, in the manner of a jack-towel, round the said cylinder, and also round another cylinder not supported

supported by the platform, but so placed as that the tension of the said web shall not prevent or impede the requisite motion or adaptation of the said first-mentioned cylinder, as herein before described. A third cylinder is applied in close contact with the second, so as to press the web of felt between them; and the said third cylinder communicates, by means of another web or felt, to and with an additional pair of pressing cylinders. The relative situations of the cylinders here described will be more perfectly apprehended and understood from the description hereinafter given of the manner of working, and the uses of the parts of my said machine. And I do declare, that the two last-described cylinders are not essentially necessary, though the same are adviseable and convenient; and also that other cylinders, as leaders or guides for the manufactured paper, may be applied and adapted to my said machinery, in case the same should be in any particular instances thought adviseable or advantageous.

Lastly. In order that the method of making and using my said machine may be more clearly apprehended and understood, I do here recapitulate that the same consists of, first, a number of moulds, of the description called laid or wove; any number of which (being of the same size or denomination) are capable of forming one long mould, in which situation the said moulds are hooked or otherwise fastened together; secondly, of a platform to receive the said series of moulds; and, thirdly, of a vessel and trough from which the paper, stuff, or material is caused to flow upon the said moulds; and, fourthly, of a set of cylinders which take off and receive the paper.

The action of, or process to be performed by and with the said machine, is as follows.

A series

A series of moulds is duly placed and connected upon the platform, so as to occupy the same. The machinery is then thrown into gear with the first-mover, which causes the first-mentioned cylinder, and also agitating axis, to revolve at the same time that the paper, stuff, or material is permitted to flow from the trough and fall upon the moulds. The first-mentioned cylinder, which is connected with the platform, rests upon the moulds, and, by means of its felt, takes hold of that mould which may be immediately beneath it, and causes the whole series to advance by an uniform motion the edge bars of each mould; being thrown and kept back by an obstacle or projecting piece on each side of the platform previous to its arrival at the cylinder. (Or otherwise the said cylinder may take hold of the moulds by means of teeth; or the said motion of the moulds may be produced by various well-known means of direct or indirect connection with the first-mover.) As the moulds advance, a workman who stands near the agitated end supplies and connects other moulds in succession; and so likewise the moulds are disengaged and taken away in succession by a workman who stands at the other end of the platform. By the continuance of this process the moulds which have received the paper, stuff, or material, which is duly distributed upon their surfaces, do arrive beneath the first cylinder of which the felt web takes off the paper, and conveys it to the first pair of pressing cylinders, whence it proceeds to the second pair, and afterwards to any fit place of reception. And by continuing the said process, the said paper, whether laid or wove, may be manufactured of an indefinite length with separate moulds, as in the said letters patent is declared and set forth.

In witness whereof, &c.

Specification of the Patent granted to HENRY FOURDRINIER, *of Sherborne-lane, in the City of London, Stationer and Paper-maker; for a Method of making a Machine for cutting Paper on a different Principle from any hitherto used.* Dated July 24, 1806.

With a Plate.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said Henry Fourdrinier do hereby declare that my * said invention, and the manner in which the same is to be carried into effect and practice, are described in manner following; that is to say:

In the drawings hereunto annexed, Fig. 1, (Plate XV.) represents, by an upright section, the frame and mechanism of an apparatus for carrying and cutting with a knife or straight edge.

Fig. 2 represents the same apparatus, by an upright section, by a plane at right angles to the plane of the section Fig. 1.

Fig. 3 represents the whole of my said machine by an upright section.

Fig. 4 represents the said machine by an horizontal section or ground plan; and throughout each of the said drawings the same letters of the alphabet do severally denote the same things.

a shews the axis and handle by which a small vertical wheel is turned. The wheel *a* drives another wheel *b*, which communicates with a third wheel *c*; upon the axis of which is a less wheel or pinion, which drives the horizontal wheel of a screw, which carries down a frame, having at its lower part or termination a knife or straight

* See note, p. 321.

edge,

edge, placed or disposed so that the line of the said edge shall be at right angles to the run of the screw. In Figs. 3 and 4 a well-connected horizontal frame is exhibited; round which an endless web or cloth *l m n o* is made to circulate by means of the wheels, cylinder, and leading rollers, which are clearly shewn at *i k r n*; or otherwise, the said web may be fastened to each of the end rollers or cylinders *i k*, and worked by winding and unwinding the same, instead of making the said web endless by joining its extremities. The upper part *l m* of the said cloth or web is supported by a table or platform, which constitutes the upper part of the frame-work; and upon the said upper part a number of similar blocks or pieces are laid close beside each other (as represented by the parallel lines and divisions along the lines *l m*, in Fig. 3); and upon the said blocks or pieces, the paper, usually consisting of a great number of long pieces or sheets, is placed or laid. *p p* represents a frame or carriage for receiving and supporting a roller containing a quantity of the said paper, to be applied or disposed upon the platform by rolling back the carriage, as occasion may require.

The structure of my said machine being thus completed, I make use of the same, as follows: When a portion of the paper hath passed to a sufficient distance beyond the knife towards the end *k*, I depress the said knife by turning the handle *a*, and cut off the said portion, which may amount to a ream, more or less, according to the charge or number of long pieces or sheets put into the machine. This being done, I remove the said portion so cut off, and also the block or blocks, or pieces of wood, which were disposed beneath the said portion. And I do also place other blocks beneath such additional portion of the length of paper as shall or may have been brought forward upon the other end of the platform towards

wards *i*, by the working of the machine as aforesaid, or laid down by means of the carriage *p*; and in this state of the operation I again raise the knife, and then turn the handle or handles, which give motion to the web, and to the paper thereon, until a like portion, or any other acquired portion or part of the said paper, shall have advanced, as before, beyond the said knife, towards the end *k*, and I then cut off and remove the said second portion. And I do proceed in the manner aforesaid until the whole of the paper applied to, or disposed in or upon my said machine, is or shall be cut into such portions, or reams, or quantities, as the nature and kind of the goods, and the demands of the market, may require.

And, lastly, I do declare that my said machine may be constructed with considerable variations as to the form, dimensions and structure of the several parts of the same respectively; but that such and the said variations are not needful to be described to any workman who may or shall be sufficiently skilled in mechanical constructions to be employed in works of this or the like nature *. In witness whereof, &c.

Specification of the Patent granted to JOSEPH BRAMAH, *of Pimlico, in the County of Middlesex, Engineer; for a certain Machine, whereby valuable Improvements in the Art of Printing will be obtained.*

Dated October 15, 1806.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, and in pursuance of the said recited letters patent, I the said Joseph Bramah do hereby declare that my said inven-

* The drawings are marked with several letters to which no references are made.

tion consists as follows, and is to be performed in manner hereunder delineated or described. But before I proceed to give such description or delineation of the apparatus and methods I mean to use, I think it proper first to shew what ideas the invention comprehends, and what are the essential particulars on which I mean to rest the peculiar merits of my invention, and which are briefly as follows; that is to say:

First, I propose, by the use of one single compound and transposable type, very simple in its nature and construction, to enable any person but little or not at all acquainted with the ordinary methods of printing to take correct copies, or print off, any work that ever has appeared in any language, and also such as may hereafter appear; and this novel and bold effect I mean to produce or provide for by a machine or type which will not, in performing to the amount of all I state, either require a single letter to be taken out or added. I also propose by the same simple apparatus to be enabled to print, either in whole lines or at intervals, in arithmetical figures, any number or numbers which are comprehended between an unit and a row of the ninth digit number arranged in a line, to the amount of twenty-six or more, as may be required. I propose also to perform all that I have hitherto described by the use of engraved letters and figures, as well as type letters as already mentioned, so that the work performed shall have the precise appearance of the finest copper-plate engravings that art can produce; and in both the foregoing instances the characters necessary in every respective language can be introduced as well as the Roman or Italic.

Secondly, I mean also, by the help of an apparatus precisely on the same principle as that already mentioned, and hereunder to be described, to print, either in colours or by impression only, all kind of piece goods, paper, &c. or

or any other article or thing, such as leather, metals, or any other article on which impressions or ornaments have been usually made. What I mean by piece goods is such as linen, calico, muslin, cambrick, silk, sattin, woollen, cloth, or any other article of manufacture produced by weaving, felting, or otherwise. I also mean to stain, or lay on, or print, ornaments, lines, or figures, by this process, on woods, metals, or any other substance time and experience may suggest as eligible for this purpose. I mean also in some instances to use my machine or printing apparatus, in the case of printing goods, sometimes with prints or figures cut or raised on the usual plan, and to take the impression by a force periodically used; and sometimes on the rolling or circulating plan, and with engraved figures or lines, on the copper-plate principle; and in the latter instance I mean to introduce perpetual and self-acting inking, or colour boxes and wipers, so that the colour or ink may be constantly introduced, and the ground effectually whiped clean, by the machine's own action, as the process of printing is carried on. These particulars as above described comprehend the particular merits and effects which I had in view when I commenced my study and labours to obtain the valuable improvements stated; and I now come to lay before the publick as faithful and unreserved a delineation and detail of the nature and construction of my machinery, and the methods of using them, as the infant state of so important an undertaking will enable me to give, and which is as follows; that is to say, in accomplishing the objects stated in my first proposition, I construct machinery in the following way.

First I take an axletree, or cylindrical roller, made of iron, brass, or other metal, or wood; and, whatever may be its required length, according to the scale of printing,

 or

or its diameter, it must be turned perfectly true, smooth, and parallel from end to end, with pivots, or other preparations for mounting it on a stationed frame of wood, or other materials. This done, I then take twenty-six wheels or rings, of metal, wood, or other materials suitable to the intended work; and which wheels or rings must be turned, or otherwise fitted on their sides, so as to closely fit side by side, as true and close as possible; so that when a hole is turned in the centre of each to exactly fit the axis or cylindrical roller above described, the whole twenty-six wheels must be put thereon, and confined by a flaunch at each end, so as then to represent a large roller composed of rings or wheels; and which rings or wheels may (when the apparatus is to be used for plate printing) be turned on the periphery or external surface perfectly cylindrical, smooth, and true, from one end to the other, as directed for the axis. The whole will then appear one solid roller or cylinder, without distinguishing the wheels or rings of which the roller is composed. The diameter of this compound roller must be such as will receive the size (with proper intervals between) of all the six-and-twenty letters of an alphabet, and also the nine arithmetical numbers and a cypher, with proper intervals also as above. These letters and figures must in the present instance be engraved in succession, and at equal distances from each other, around the periphery of each wheel, each letter and figure standing so as to read the reverse way across the wheels, and the longitudinal way on the surface of the roller, or from end to end. This done, all the wheels must be again mounted on the axis or inner cylinder as before, and each wheel left so as it will easily move or turn in any direction thereon, but with as little shake as possible. The cylinder must then be mounted on a proper frame, and its

axis

axis or inner cylinder stationed at each end, so as it will not turn, but so as readily to admit all the wheels to turn in either direction, as before mentioned. When this is accomplished the apparatus is complete, and ready to be used. But before I proceed I must observe, that, when letter-press printing is the object, these wheels must have as it were points or spokes, or parts projecting, at proper intervals, truly divided round each wheel; on which spokes or prominent parts the intended letters and figures as aforesaid must be cut, so as to represent those letters or figures exactly which are used in a common printing type. These, and likewise all the stops or marks used in printing, may be introduced when necessary. In this instance the wheels need only be made of a proper diameter to admit any of these stops or marks, in addition to the letters and figures which the nature of the work may require. When the whole is thus completed the apparatus is ready to go to work, and the most ordinary capacity will easily discover, that by turning these wheels on the general axis till the respective letters or figures (which are demanded to compose as many words, or monosyllables, in one line as the twenty-six will reach) are brought into unison in a straight line from one end of the roller to the other, that the machine will be then ready to receive the ink; which being put on in the common way or otherwise, and an impression taken by a squeeze, that then so much of the intended work is executed, and a line is completely printed; and after which the wheels may again be turned, so as to produce another line; and thus this simple process may be carried on through all the changes that can be made with the number of wheels stated; and, by the addition of more wheels on the same axis, extended in its length, it may be continued *ad infinitum*.

Secondly,

Secondly, in printing piece goods and other articles, as stated in my second proposition, I mean to compose the apparatus or printing machinery just in the way described, only that I shall generally adopt the engraved plan for this purpose, and not the plan with raised figures used by the calico printers and paper stainers, except in some instances, where I shall then have sprigs, flowers, and other ornaments, cut on the points of spokes or prominent parts, with intervals between, as already described for the accomplishment of the objects of the first section, and where it will be obvious that I can vary patterns endlessly, and print them by the same machine, and so that no two pieces shall ever be alike in pattern, notwithstanding the machine may be kept at work night and day for numberless ages, and without stopping a single instant. However prodigious this assertion may appear to some, yet a very little consideration will evince the truth of it; because it must be recollected that I shall have in this application of the principle not only in my power those changes which will result from turning each wheel upon the axis of the printing roller, as in the instance of letter and figure printing, which will always produce a variety equal to the arithmetical combination of as many progressional numbers as equal the number of different figures comprehended on each wheel; but I can also produce new patterns in the same proportion, by transposing or differently arranging each wheel in its relative station on the axis of the printing roller. I mean by shifting and changing these wheels on the axis, the same as a number of penny pieces may be piled with relative variation according to their number, may be correctly ascertained by arithmetical calculation, and therefore will admit of no dispute. In composing these rollers for printing, as mentioned in section second, the principle is just the same

as

as for the purposes of section first, with the difference only of having the means by a screw-nut, or otherwise, of fastening the rings or wheels upon the axis permanently, after they are changed or reset for a new pattern; and, that the roller for this purpose will have to turn upon its own axis, like a roller in a common calender, and not the wheels turn upon the stationed axis, as described in letter and figure printing. When a roller for this purpose is completed, it must be mounted upon a frame in contact with another roller, like a common calender; so that the piece or article to be printed may be passed between just as in a calender, the two rollers having a necessary pressure on each other to cause a good impression, the same as is performed by the rolling press used by those who print from copper-plates.

This apparatus being thus far completed, next comes my method of perpetual inking or putting on the colours, and which is as follows: i. e. when the printing roller is thus hung, and ready to be used, I take a wooden or metal box, or trough of suitable dimensions, which I call an ink or colour box. This box is made without a bottom, and consists of a rim only as capacious in its largest dimensions as will reach from one end of the printing roller to the other. The under part of this box or rim of a box is first cut exactly to form a segment to the printing roller's surface, and is then fitted by grinding or otherwise so nicely to the roller's periphery as to be water, oil, or colour tight; and is also pressed by some elastic or gravitating means so much as to always keep it close when the printing roller is turned about, and while the box is stationarily held from turning with it by proper attachment to the frame. On the leaving side of this inking or colour box is fixed what I term a wiper, made of wood covered with leather, or other materials proper

for

for the purpose, and which is kept by proper means very severely pressed against the surface of the printing roller from end to end, in order that if any ink or colour should escape the box and remain upon the roller's surface as it turns when the piece is in, this wiper may take it off, and thereby prevent goods from being smeared with the ink or colour. When the piece goods or object to be printed is to be all of the same colour, the inking box may be all its length in one cavity, but when stripes of various colours are intended, a corresponding number of partitions must be introduced at stationed distances agreeable to the pattern to be printed, these partitions being always put so as to fall with their thickness (which must be as inconsiderable as possible) exactly equally divided across the joints between one wheel and its neighbour, so that the partition may not interfere with any part of the device engraved upon the periphery of the wheel. These partitions must also, like the main rim of the inking box, form segments to the printing roller, and be made fluid tight in the way above described for the latter. When this machine is thus equipped, and the piece adjusted for the operation, the inking box may then be charged with colour as the pattern may require, and then the periphery of the printing roller forming as it were the bottom of the box, as the roller is turned about, the engraved figures or lines, or whatever else may be engraved thereon, will naturally and unavoidably be filled with ink or colour as the roller turns, and the box being on the most elevated part of the roller and the piece to receive the impression on the under side, it will of course carry the ink or colour down on the leaving side, and come up empty on the driving side, till it again passes its surface with the pattern under the inking box, which will as constantly and without a possibility of failing both

ink

ink or colour the mould or plate with certainty, and a degree of equality that never can be obtained by hand, and at the same time with great expedition and accuracy of effect. I have now to mention that when I print pieces with patterns requiring different colours, otherwise than in stripes, such as flowers and other figures, I have a plurality of these printing rollers under which the piece successively passes; and on which rollers, each has that part engraved which is to convey the colours respectively to the piece, just the same as is at present done by shifting moulds in the common way.

Having now given as clear a description of this invention as I am able in this stage of such an undertaking; I declare it to be sufficient to demonstrate the principle to any scientific mind, to as great an extent as can be reached by contemplation; but, doubtless, time and practice will (and perhaps before a second apparatus is completed) suggest improvement upon improvement, and not even here but to the end of time; but I hereby pledge myself to bring forward for the benefit of the public, during the period of this patent, every improvement my abilities (with all the aid derivable from new light) can suggest and introduce. I have now nothing more to add, but to observe, that I can perform or produce all the effects stated in the above specification by means of flat types, moulds, or prints, made in this compound way, and I may, doubtless, in some instances apply them; but as I prefer the rotary principle, and intend to confine myself chiefly to the use of this plan, and from the little necessity I see of minutely describing a thing so extremely obvious, and to shew also that this idea or mode of applying the principle forms a part of the invention which I claim, I shall just observe, that when I construct this apparatus on the flat principle, the type, mould, or

 print,

print, will be composed of an equal number of sliders placed by the side of each other with close joints, just similar to what would be produced by sliceing off the periphery of those wheels I have already described, and stretching them out like thin slips or ribbands, which slips being placed side by side as above mentioned on a flat or level plain, with all the letters, figures, ornaments, &c. uppermost, so as to form a type, mould, or print; as aforesaid, it is evident that by sliding each of these in either direction, so as to bring the required letter, figures, or other marks necessary to produce the effect into unison or in a straight line, as before directed with the wheels, the same effect may be produced, and printing may be carried on by this machine to the like extent; and perhaps practice may evince eventually that this method of applying the principle, may in many instances be preferable to the former. I here allude to every species of printing comprehended in my description for the rotary application; and I also claim the exclusive use of the flat apparatus, as far as it may be possibly applied.

In witness whereof, &c.

Specification of the Patent granted to JAMES WINTER, *of Stoke-under-Hamdon, in the County of Somerset, Glove-manufacturer; for a Machine for sewing and pointing Leather Gloves with Neatness and Strength, much superior to what is effected by Manual Labour.*

With a Plate.

Dated February 20, 1807.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said James Winter do hereby declare that my said

said invention is described as follows; that is to say: The drawing, Fig. 5, (Plate XV.) represents a pedestal, on which the instrument called the jaws, Fig. 6, are fixed. These jaws, which are made either of wood or metal, are intended to hold the gloves for sewing, and indexes for the direction of the needles, suited to the different kinds of work required.

Fig. 7 is a perspective view of an index; and Fig. 8, 9, 10, 11, are plans of the tops or faces of different indexes, as they appear when closed. These indexes are made with grooves on their tops or faces, to give proper direction to the needles, and contain from eighteen to thirty grooves in an inch, in an oblique or strait direction, as the work may require. They are from one-eighth to three-eighths of an inch in breadth, and from one to four inches long, more or less, according to the nature of the work, and the expertness of the person employed. They are varied in shape, either straight or circular, corresponding to the part of the glove to be sewn therein, and may be made of ivory, bone, or brass, or any fit material. The grooves in the index must be of the depth required for the stitch, the leather being placed even with the face or top of the index, for its proper situation for sewing.

Fig. 12 is a perspective view of the apparatus when ready for use. A, the index fixed in the jaws B, C, a joint by which the jaws are opened at pleasure, to receive the material intended to be sewn or ornamented. The opening is effected by placing the foot on the treadle D, which communicates by a wire or cord to the pin F, fixed on the jaws. G is a spring which closes the jaws when the pressure of the foot is taken off, and by which the leather is firmly held to receive the needles as

they pass through the grooves on the face of the index. H, the joint of the jaws, fitted into the pedestal represented in Fig. 5, and fastened by a pin or pins. The pillar I, about three inches diameter, is inserted in the block K, and turns there on a pivot, for the convenience of persons working either side of the index. L, a screw (see Fig. 7) which confines one side of the index, and by which it may be regulated by moving it to the right or the left, that the grooves may be kept always opposite each other. The height of the machine should be adapted to the convenience of the person who is to use it; generally about two feet four inches to two feet six inches, but it may be varied in height by raising or lowering the jaws Fig. 6, in the pillar Fig. 5, by means of the pin or pins.

The chief novelty which I claim in this invention is the application of the index for the sewing and ornamenting of gloves, and the easy and convenient method of holding them by means of the jaws. It will therefore be seen, that other instruments, similar to the jaws, may be used in their stead, and the jaws, or such other instruments, may be fixed in a variety of ways instead of the pedestal; but I have described this apparatus as one of the most convenient that occurs to me.

Figs. 8 and 9 are plans of an index, grooved, to receive the needles, by which the different kinds of sewing and ornamental-work may be performed with one, two, three, or four needles; but the general practice of sewing is with two needles, and the ornamental work with one to four.

Fig. 8 is an index marked and grooved for sewing with two needles; the groove of the leading needle (that is every other or second groove) might be marked with a black

black dot, or otherwise, as a guide to learners; the second or intermediate needle will be directed by the stitch of the first, and fill up the space left. The silk should be twice the length generally used, and threaded at each end; the sewing should commence in the middle of the silk, and when concluded the two ends should be tied together in the inside.

Figs. 9 and 10 are generally used for ornamental work.

Fig. 9 is generally used for fancy work, where two or four needles may be needful.

To make a silk cord, every fourth stitch must be taken by the first needle, when the second, third, and fourth follow, and fill up the space left by the first; and this may be varied by passing the needle or needles through every groove, or every second, third, or fourth alternately, by which a very great variety of patterns may be obtained at pleasure.

Fig. 10, for one or single, and two or double seaming, where the grooves are omitted, that the silk may cover the leather, and only serve to regulate the depth and straight direction of the seam. For two, or double seaming, one of the indexes has a small groove in the inside to receive the first seam, while the work of the second is performing.

Fig. 11 is generally used in setting in thumbs. As a guide to learners it is best to make the grooves of Fig. 9 in pairs, as in the drawing. It may be proper to observe that no removal of the leather is to take place in the index before every needle is brought up to its proper place behind the leading one; and the most expeditious method of sewing the thumb and the finger-tops, is in the hand, in the usual way. A very little practice will make the

the workwoman familiar in taking on both needles with strength and neatness.

In witness whereof, &c.

Observations by the Patentee.

There cannot be a greater recommendation to a leather glove than the strength of the sewing, and nothing is so well adapted for that purpose as the machine above described.

What has always been called double sewing, has only been an increased number of stitches; but the sewing performed by the aid of my machine is double in the strictest sense of the word, as the glove is sewn over twice, the second sewing having no connection whatever with the first; and its strength and beauty are regulated by the machine: besides the great support one sewing gives the other, should either of the silks be worn off, or torn by accident, the glove is still compleat, as a sewing much stronger than what is usually given to gloves remains. No fastenings on or off are made, (which has always been a defect in gloves,) as the sewing commences in the middle of the silk, and when concluded the two silks are tied together. To this very great advantage attending the strength and neatness of the glove, the pointing adds not a little, as its beautiful exactness is equal to copper-plate, the register-point forms a compleat silk cord, and has a nice effect: in fact, nothing is left to the blunders of bad work-people, but every thing reduced to a system.

Specification

Specification of the Patent granted to JOHN FLETCHER, *of Cecil-street, Strand, in the County of Middlesex, Esquire; for a Composition, for Agricultural Purposes, which is not only of the greatest Value as a Manure, but is also extremely efficacious in the Destruction of the Fly in Turnips, Snails, Slugs, Ants, and the Majority of those other Insects which are detrimental to Vegetables, which Composition he usually denominates* "Prepared Gypsum." Dated October 21, 1806.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said John Fletcher do hereby declare that my said invention is described, and the said composition is manufactured, composed, and produced in manner following; that is to say: Take any quantity of gypsum, selenite, or natural sulphate of lime, of which that kind which is usually denominated *fibrous gypsum* is the best. Take also any quantity of those oyster-shells which are found betwen high and low water marks on every part of the sea-shore in the vicinity of oyster-beds, and which have, by the long-continued action of the water and attrition against the sand, become deprived of their dark-coloured exterior crust; or, in lieu thereof, take fresh oyster-shells, and clear off the dark-coloured exterior crust with a rasp, or other convenient instrument. Take also any quantity of common heavy spar, baroselenite, or natural sulphate of barytes, of which the purest specimens are the best. Reduce each of the three before-mentioned ingredients separately to powder, by grinding, pounding, or any other ordinary or convenient mode of pulverization. The powder of the two first-mentioned ingredients should be of such a degree of fineness as to pass

pass through a wire sieve, the meshes of which are from one twenty-fourth part of an inch to one-twentieth part of an inch square; that is, of such dimensions that from 400 to 576 of the meshes are contained in every square inch of the wire-work; but it is better that the baroselenite be powdered considerably finer. The meshes of the sieves generally used for this last-mentioned powder are from one sixty-fourth part of an inch to one-fiftieth part of an inch square; that is, of such dimensions that from 2500 to 4096 of them are contained in every square inch of the wire-work. Lastly, mix the three before-mentioned powders in the following proportion; that is to say, to 1000 bushels of the pulverized gypsum add 100 bushels of the pulverized oyster-shells and five hundred weight of the pulverized baroselenite, and the composition is made.

In witness whereof, &c.

Experiments on the Culture of Carrots.

By Mr. W. Wallis Mason, *of Goodrest Lodge, near Warwick.*

With Engravings,

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

THE purport of this communication is to explain with a degree of accuracy, the general, and as far as possible the best method to cultivate carrots. I shall therefore endeavour to set aside those prejudices, which frequently occur in every branch of agriculture; while I give a brief statement of particulars, which experience, assisted by numerous

numerous comparisons, has induced me to consider as best for adoption for rearing the plants, as well as most judicious in the application of the vegetables when cultivated. In Suffolk, the culture of this highly valuable root has been carried on for ages; but of late years it has very much increased, and furnishes the best criterion of its worth; various have been the attempts to extend the benefit more generally throughout the kingdom, but with little success; imaginary difficulties arising in the minds of cultivators, which I hope to obviate by a more minute detail, the observance of which will enable any practical farmer, on a proper soil, to raise a crop, which will at once be productive of great private advantage and public utility. On most farms it will be found, that a considerable proportion of the produce from the best land (the meadow and upland pasture) is consumed by the laborious cattle, and the lean and rearing stock during the winter months. The carrot system may be carried on, on inferior arable lands, and the produce, by judicious application, will be found to excel far beyond general expectation that of the grazing land, which will in consequence be appropriated to great national advantage, by furnishing an additional supply of animal food, of wool, and the produce of the dairy.

A red loamy sand is at all times to be preferred, as free from stones as possible; but very large crops may be grown on any land, which is not of a too tenacious or binding quality, with sufficient depth of soil.

In order to increase the luxuriance of the root, it is necessary to remove the soil to the depth of 14 inches: this is easily accomplished, by first ploughing the furrow seven inches deep in the usual manner, then follow with the second plough in the same furrow, which, by the assistance of an additional horse, brings up the soil from

 the

the depth required. The first plough continues to turn the fresh furrow to the bottom of the double furrow, and being followed by the double furrow, as in the first instance, the soil becomes completely mixed and ready for the reception of the seed.

The first furrow is seven inches deep, and is removed into the ....
second furrow, of fourteen inches deep; this in rotation becomes the first stratum.

The lands, or stitches cannot be too wide, from 18 to 25 yards.

It is necessary to observe, the land at all times on which this crop is intended to be produced, should be in a perfectly clean state; a barley stubble which succeeded a fallow, &c. Yet few crops turn out more productive than those cultivated on clover, or lays of artificial grasses; ploughing the same as on a barley stubble.

A rule which in most instances holds good, must not here be neglected, that of getting in the seed directly after the ploughs; a neglect of this would be attended with the worst consequences; on stale land the weeds would, in a short time, completely get the better of the young plants, and thereby occasion a great deficiency in the crop.

Five pounds of seed is commonly sown per acre; but as its value, comparatively speaking, is very trifling with the advantage of a good plant, I never recommend less than six pounds per acre. In a dry season there is a great benefit in steeping the seed for twenty-four hours; to prepare it for the drill, or for sowing, it should be well rubbed with the palm of the hand against the side of a tub, to destroy the small fibres and prevent their adhesion, and a proportion of fine sifted marl and saw-dust mixed

mixed with it; the proportion two-fourths marl, one-fourth saw-dust, to one-fourth of seed.

Drilling is indubitably the best way to get in the seed, from six to nine inches asunder: the advantage is obvious; the carrots stand the winter much better: from the tops of the vegetables being nearly buried in the soil, the green head is only visible to the eye, and it is very rare to see the smallest part of the red carrot above the surface. An additional advantage in this mode of cultivation is, the great facility it furnishes in weeding and hoeing, which, in a district not hitherto acquainted with this useful branch of agriculture, must render it in a two-fold degree desirable.

Carrots in the early state are very tender plants, and very slow in growth; I have frequently noticed a field scarcely visible to the eye, three weeks or a month after sowing, which has turned out a most abundant produce. It is frequently six weeks before they are fit to hoe; but to prescribe any rule is impossible, since the vegetation of every description of plants so much depends on the season. I shall only observe, the most proper time to commence weeding or hoeing, is soon after the plants gain the parsley leaf, or about half-inch out of the ground. Every vegetable intended to be thinned or separated by the hoe, cannot well be done too early, since from general observation it is clearly ascertained, that the smaller the plants, the greater is the number left; and as a second hoeing is absolutely necessary (if it is only to promote vegetation by loosening the surface), the plants may then be distributed as requisite. In hoeing of every description, it is always necessary to stir every part of the soil possible; in this instance it must on no account be neglected.

The season for sowing, is from the middle of March to the 12th of April. In dry weather it is best to leave the seed rolled down. The land should always be harrowed after drilling or sowing; from the nature of the plant, a pulverization of the soil is requisite. It is, however, useless to detail particulars of this sort, which must in so material a degree depend on the state of the season, in which the judgment of the practical farmer cannot easily fail; suffice it to say, the lighter, the finer, and the less binding the soil, the better vegetation must flourish.

With respect to the best method of cleansing the young crop, I have only to observe, that nine times in ten it answers better to weed by hand, than to hoe the first time; this rests on a supposition, that the crop is much encumbered by weeds; on the contrary, (which is rarely the case) supposing it perfectly clean, the hoe will answer every purpose requisite. There is great judgment to be observed in the first hoeing, particularly to leave the plants sufficiently thick, and not to bury them in the process; should this be done, your fairest prospects will at once vanish. The women and children employed to weed, should not be suffered to pull a single carrot plant; the hoe effects the purpose of setting out in a superior manner, and should within two or three days follow the weeders. I have frequently seen the land so much covered with weeds, that the plant of carrots was extremely doubtful; after hand-weeding, a very good plant was seen, which would have been destroyed in great measure, had the hoe been previously used. One weeding and two hoeings are generally sufficient; by the time they are accomplished, the carrot-tops generally are of sufficient growth to shade the land. The proper hoe to be made use of should be four inches by one and a half inch (see Fig. 4, Plate XVI.) and always kept very sharp.

Carrots,

Carrots, like turnips, and other vegetables intended to be housed for winter, should not be taken up before they are full grown; they never answer better than when used from one to four weeks after they are out of the ground. They are little liable to injury in winter; the latest time for taking up, is just before the fibrous roots begin to shoot in the spring; at which period the vegetable becomes less nutritive, at the same time injurious to the land.

By these attentions I have invariably found the cultivation of carrots extremely beneficial to the land, and not unfrequently the value of the crop equal to the fee-simple of it. The greatest produce I ever remember was eighteen loads per acre, forty heaped bushels to the load; yet I have heard of much larger crops.

Worn-out ploughed lands are renewed by the intermixture of fresh soil occasioned by the deep ploughing; and the proof is visible in many succeeding crops of corn, grasses, &c.

The same land will produce very good crops of carrots for years in succession; but in this instance manure becomes necessary. They are taken up with a narrow spade, which the labourer strikes with one hand into the ground, pressing it sideways at the same time; he draws the root with the other, throwing it to the heap, where sit his wife and children to cut off the tops: the tops are left, and spread as manure to the land.

Expenses of Labour.

	s.	d.
Weeding varies from 5s. to 10s. per acre, average	7	6
First Hoeing - - - - - - - - - - - - -	7	0
Second do. - - - - - - - - - - - - - - - -	5	6
Taking up per load, and topping - - - - - -	1	2

Observing

Observing these prices, it is necessary to remark, the labourers, in dear seasons, have an allowance for flour.

To every single man one stone of flour per week, the master paying the additional price above two shillings per stone.

To a man and his wife one stone and a half per week, and half a stone per week to every additional child under twelve years old, at which time they are deemed capable of earning their own bread.

By the introduction of this judicious plan, the labourer shares the benefit of that grain which his own industry had helped to cultivate, and feels but in a small degree the oppression of the times; the interest of the master and the servant becomes reciprocal, for the price of labour continues nearly at the usual standard; had it been otherwise, the farmer must have suffered when his commodities became of less value.

The annual rent of those lands on which carrots are generally grown, is from 5s. to 20s. per acre; but I have invariably found the profit by far the greatest when the best soil has been made use of:—

A good crop on land worth 5s. per acre	-	7 loads.
———— on land worth 10s. per acre	-	9 do.
———— on land worth 15s. per acre	-	11 do.
On the best land, as I before remarked	-	18 do.

The advantage in preferring good land is obvious, the chief expenses being nearly the same as on poor soil; the additional labour consists chiefly in taking up.

Carrots are sometimes sown when the land has received but a single furrow, a sure badge of indolence. The annexed Drawing (See Plate XVI.) is to prove the necessity of deep ploughing, by means of the double furrow. Fig. 1, is the shape and comparative size of a carrot

rot grown on a single furrow; the earth below where the soil was stirred, acting as a repellent, checks the growth of the root, and causes it to shoot laterally. Fig. 2, is the comparative growth and shape of a carrot grown on the double forrow. On all soils which are adapted to this branch of husbandry, the first ploughing may be done by a pair of horses abreast; the lower, or double furrow, by three horses abreast. The nearer the cattle are to the work, the greater the purchase; they labour with greater spirit in sociable pairs than in a drone-like string at length. Fig. 3 will explain the manner of fixing three horses abreast to a single purchase, which will be found on a fair trial to equal four horses at length.

It is a common custom with the cultivators of carrots to raise their own seed; it requires little attention, and the crop is seldom known to fail.—For this purpose choose such carrots as are in no respect injured by frost; and the handsomest of a middle size; trim the green top, leaving about an inch of it, and cut two inches off the extremity of the root. Plant them in double rows, a foot wide, and six inches in the row; the interval of the double rows three feet: this is requisite, as the seed does not ripen together. The path or interval serves to gather the seed, which must be done daily as the heads of seed arrive at maturity: it is frequently three weeks before the crop is cleared. Spread the heads of seeds to dry on a floor, or, in dry weather, on the ground; afterwards separate the seed from the stalks with a comb. The season to plant carrots for seed, is the latter end of February or the beginning of March, when the severe frosts are over.

Having explained, in as concise a manner as possible, what is necessary to be observed, to enable the practical farmer to cultivate this highly valuable root, in districts hitherto deprived of the great benefit it affords to the com-

community, and the great profit to the cultivator, free from all theoretical and speculative opinions, I proceed to a short detail of the use and application of carrots when cultivated. On their utility for family consumption, it will not be necessary to dwell; I have therefore only to remark, since vegetables are found to be more or less nutritive in proportion to the saccharine matter they contain, but few vegetables will be found to excel them. I have known large crops of carrots sold, for the London market, at forty shillings per load, delivered at a port four miles distant from the land which produced them, a price for which a ready sale will be found in any populous town, during the winter season: for this purpose they should be assorted; all the over-grown and crooked ones reserved for home consumption, for which they will answer as well as the others; and when topped, half an inch of the green crown left on: for this purpose they are not usually washed. For home consumption I have invariably found them to answer best for the use of cart-horses; when designed for the food of other cattle, of any description, the green top must be entirely cut off, and the carrots washed perfectly free from dirt and sand. It is necessary to house them three or four days at least before horses are fed with them; a neglect of this is sure to be attended with dangerous consequences. It is generally known that the cucumber, when left a short time in water, absorbs a proportion of it; the carrot does the same, in a less degree, yet sufficiently to produce a considerable degree of fermentation by the heat of the animal's stomach; and griping is occasioned thereby. To render them salutary, the time mentioned is sufficient for evaporation.—Washing is easily and expeditiously done, by putting a large mash-tub, three parts full of carrots, then pouring cold water on them, stir them and throw

them

them out with four-pronged muck-forks; after which process they may be laid under cover in large heaps, as much as six or eight loads in a heap; secured from frost and rain, they will keep two or three mouths: it is however not right to suffer them to remain so long, in which case they shrivel even to two-thirds of measure; and although they become more nutritious, from the loss of aqueous particles, it is not sufficient to compensate the deficiency. Carrots are extremely valuable when applied as food for cart-horses: when properly fed with them, they are in the greatest vigour and health; and their coats are as fine as the best groomed coach-horses, even in the depth of winter, and exposed to the inclemency of the season in a straw-yard. For home consumption, I have invariably found them to pay more, by one-third, when given to horses, than to feeding cattle. After a variety of experiments, I have found the following manner of applying them to be the best:—To each cart-horse, one heaped bushel per day, with as much cut provender as he could eat; the latter should be of the first quality. I recommend two-thirds good wheat or oat straw, and one-third clover. Wheat-straw is best; oat-straw next. Barley-straw is frequently given; but never preferred, from its griping tendency. Horses cannot eat too much cut food. When returned from work, they should always be baited with it, or drink their water before carrots are given, and plenty of dry food given with the carrots: the dry nature of the one corrects the cold quality of the other. There is not any occasion to cut the carrots, but to mix them with the cut food, and feed them in the manger. Horses used to carrots will prefer them to oats, when given together. If the straw and clover are not of the first quality, oats should be given in proportion. By this method of feeding, there is a saving of at least two-

thirds of the hay usually consumed; corn is dispensed with; and horses will be in better condition than when fed with hay and corn only, supposing each horse is allowed with hay half a peck of oats per day.

Great care must be taken never to give carrots when horses come to the stable heated by work.

Carrots are not proper food for riding-horses; nimble exercise causes them to be laxative; and as they will sometimes produce griping, I shall insert a prescription which has been proved by long experience, together with the treatment to be pursued in such cases.

Oil of Turpentine	- - - - - -	1 oz.
Castile Soap	- - - - - - -	1 oz.
Flour of Mustard	- - - - -	½ oz.

On the first symptom this mixture should be given, and it will not fail to remove the complaint. The Castile soap to be cut fine, and dissolved in a quart of boiling water, the mustard added; the oil of turpentine the last thing; it should be given more than milk-warm; if the animal suffers much pain, add half an ounce of liquid laudanum. On the first appearance of the disease, the horse should be well coated, and constantly rubbed with hard twisted whisps of straw, and kept as warm as possible; should the disease increase, and the body swell much, a gallon of blood should be taken, to check the inflammation, and give time for the medicine to operate. If the symptoms increase, repeat the dose, omitting the liquid laudanum. Clysters and raking afford much relief when the symptoms first appear, and frequently remove the complaint.

Feeding cattle improve more on carrots, than when fed with potatoes or turnips; they are excellent food for

ewes at lambing time, and should be cut, or they are subject to break their mouths.

Store pigs may be fattened on carrots only, and large hogs feed remarkably well, when fed with half corn and half carrots.

Heifers in calf, which require good keep, and calve early, thrive better on carrots and good oat-straw, than on hay only—one bushel of carrots per day. Care must be taken not to give them too early or too many; in which case, the calves are liable to overgrow.

Weaned calves thrive well on this food; a peck per day is quite sufficient, more would increase the body too much.

Milking cows give more milk on carrots and straw, than on hay only. In all these instances their superiority over turnips is more, comparatively speaking, than the difference of a carrot crop rated at one guinea per load of forty bushels, to the value of turnips on the same soil; rating them as a produce for home consumption.

One heaped bushel of carrots, therefore, is equal to 18 lbs. of hay. Admitting each cart-horse to consume this quantity of hay for 120 days, it amounts to 2,160 lbs. the average produce of one acre of good pasture land.

The same animal, if fed on carrots, with the addition of the cut-straw provender, which is a substitute for corn, and adds solidity to the carrots, will require only 120 bushels of carrots, or three loads; not half the produce of an acre of arable land worth five shillings per acre.

To this must be added the great superiority in point of condition, which the cattle evince. The latter method of feeding with carrots and cut provender, is fully equal to 18 lbs. of hay and half a peck of oats to each horse.

Description of an Improvement in the Painters and Glaziers Machines, to prevent Accidents caused by their Unsteadiness. By Mr. JOSEPH DAVIS, *of the Crescent, Kingsland-Road.*

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Ten Guineas were presented to Mr. DAVIS *for this Contrivance.*

THE frequent accidents which happen to painters and glaziers, from the unsteadiness of their machines, and the consequent misery brought upon their families, have stimulated me to endeavour at the improvement of such machines.

The model, which I have the honour of forwarding to you, will, in my opinion, answer the purpose in view. Generally, as you may see, the machine may be used without the guard; and, while perfectly firm and secure, it will cause no injury to the wainscoting or paint. But where the windows are flush with the floor, and where no under security can be depended upon, the guard may be applied with advantage.

Fig. 5, (Plate XVI.) represents the machine; the part *a*, is similar to that used by glaziers, which is placed on the outside of the window. *b* is an additional moving piece, which presses against the inside of the window-frame, and is brought nearer to, or removed farther from it, by means of the male-screw *c*, and its handle *d*.

Fig. 6 shews the lower part of a window, and the manner in which the moving-piece *b*, including a female-screw, acts against the inside of the window-frame.

Fig. 7 shews a cross-bar introduced in place of the moving-piece last mentioned, which bar extends from one window-side to the other, and explains how the machine

Fig. 5.

Fig. 7.

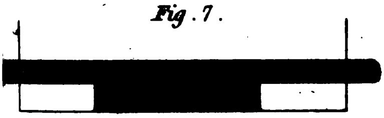
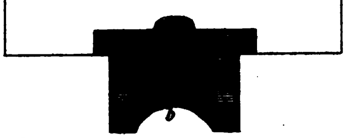


Fig. 6.



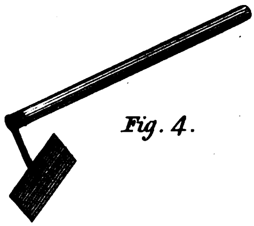


Fig. 4.

Fig. 1. Fig. 2.

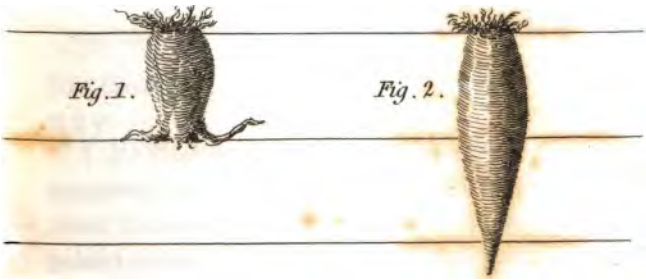
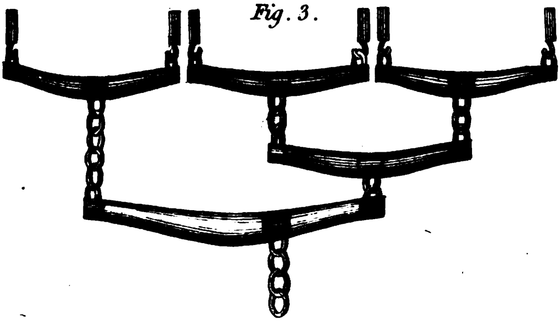


Fig. 3.



machine may be used where any injury might arise from screwing the moving-piece in the centre of the recess of the window.

The general improvement consists in the use of a screw on that end of the frame which is within the house, and which keeps the machine steady and firm, instead of the two upright irons, which are put through holes made in the top plank of the machine, in the common mode, and which occasion the machine to be very unsteady in use, and liable to accident. There are two blocks marked *d d* *, in Fig. 5, which may be occasionally put in, or taken out, according as the stone-work under the window may require.

Description of a curvilinear Saw invented by JOHN TROTTER, *Esq. of Soho-square.*

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal was voted by the Society for this Invention.

WITH the view of obviating many difficulties and expenses, which have long attended the operations of those requiring curvilinear sawing in their trade, and of public bodies connected with those trades, through the licentiousness and refractory conduct of sawyers, it has been represented to me as a measure extremely desirable, to adopt more generally mechanical powers, could such be discovered, as would preclude much mystery and manual labour.

Considering the subject in a national point of view, as connected with our naval yards in the formation of tim-

* These letters have been omitted in the original engraving.

ber;

ber; with our military departments, in respect to wheels of every description; with our whale and herring fisheries; our public and private breweries and distilleries; our East and West India Companies, and other bodies depending on cooperages, as well as other minor trades peculiarly liable to the evils complained of, I invented a curvilinear saw, which, with little aid of the most ignorant labourer, answers every purpose.

Having effected these ends, suffer me to solicit the honour of the Society's acceptance of a model, together with a drawing of my saw, sufficiently accurate for the use of those in remote situations to work by, who may wish to use or make them.

Fig. 1 (Plate XVII.) represents a bird's eye view of the saw and machinery. The dotted lines shew the spindle *a*, moving on two centers *b*, *b*, having at one end a pulley *c*, and at the other a concave saw *d* (with a corresponding convexity to the curve required to be sawed), secured on the convex side by a collar, and on the concave side by a loose collar, and screw nut.

e, *e*, two grooved plates, admitting through the top of the bench and fence *f* screw bolts fastened by thumb nuts, by means of which, and a parallel motion *g*, the fence *f* is regulated, and consequently the conductor *h* of the wood *i* admits it to be sawed through, as represented in the dotted line at any part required.

The fence, conductor, and saw, must all be curved alike; but to saw in smaller circles, with the same saw, and at the same time square with the face of the bench, a steel slider *k*, regulated by two screws, is made to press, as occasion may require, on the convex side of the saw, and raise the vertical line of it to a right angle with the bench; otherwise the top of the bench itself must receive the same inclination to the vertical line of the fixed saw.

Fig.

Fig. 2 is a front view of the saw and bench, in which the teeth of the saw are more clearly shewn.

Fig. 3 an end view of the same machinery.

Fig. 4 shews the saw, axle, and pulley, all made of iron or steel, and separated from the frame.

Description of an improved Book-Binder's Cutting Press invented by Mr. JAMES HARDIE, *of Glasgow.*

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Fifteen Guineas were awarded by the Society for this Improvement.

MR. A. Tilloch, in a letter to the Society introducing to their notice this machine, says, "the inventor claims no other merit than that of having simplified the common press, rendered it more powerful, and adapted it to work more œconomically; or, in other words, to save time to the workman. It has been found so superior to the press in common use that all the bookbinders in Glasgow and Edinburgh are adopting it. This is perhaps the best proof that can be given of its utility. The inventor has received certificates from the bookbinders alluded to, which will be sent to the Society, if they think the press worthy of their notice. Mr. Hardie, in desiring me to submit the model to the inspection of the Society, has in view chiefly to benefit the bookbinders in places remote from his residence, an object which he thinks cannot be so well attained in any other way as by the publicity which the Society is able to give to improvements deserving of its notice.

"The

"The improvement of this simple instrumen thas cost Mr. Hardie much time, and even expense; and he will be glad to receive any remuneration from the Society which they may think his invention deserves."

Twenty-three persons testified by their signatures and subscriptions to Mr. Hardie their approbation of his cutting press.

The Society has received a certificate from Lord Douglas, who very strongly recommends Mr. Hardie's press in preference to the one in common use.

The principal difference between this and the press which has been for time immemorial employed by the bookbinders, consists in effecting the business by one iron screw instead of two wooden ones formerly used. This screw works in a nut let into and screwed to the top piece A, Fig. 5, (Plate XVII.) its lower end working in a collar, screwed to the moving piece B, sliding in grooves within the two sides of the frame. C C are the guides for the plough, as in the common press.

Report on the different Methods of extracting with Advantage the Salt of Soda from Sea-Salt.

By LELIEVRE, PELLETIER, D'ARCET *and* GIROUD; *extracted by* J. C. DELAMETHERIE.

(Concluded from Page 318.)

Process of Ribaucourt.

RIBAUCOURT has sent a memoir in which he proposes several methods, but most of them may be reduced to the processes already known and described before him, whether by means of old iron, vitriol, or lead: we shall not enter into the detail of these methods; but there is

one

Pl. XVII. Vol X Second Series.

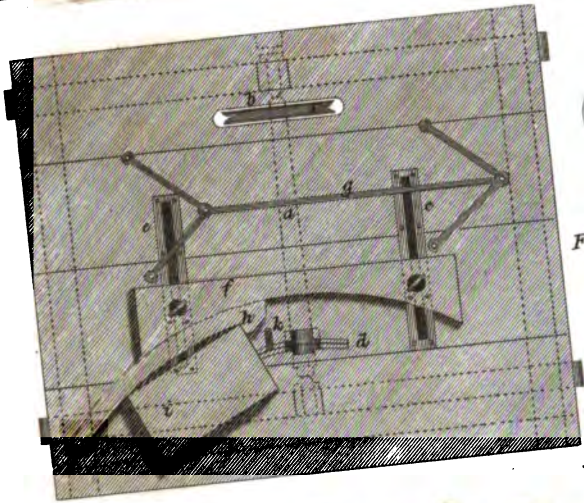


Fig. 1.

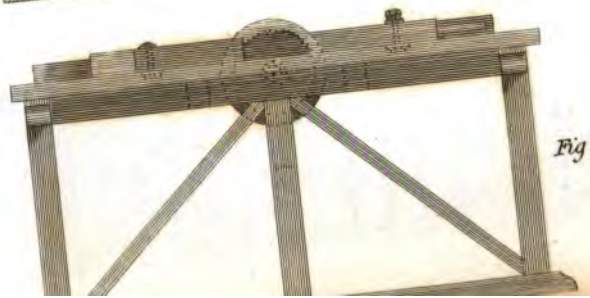


Fig. 2.

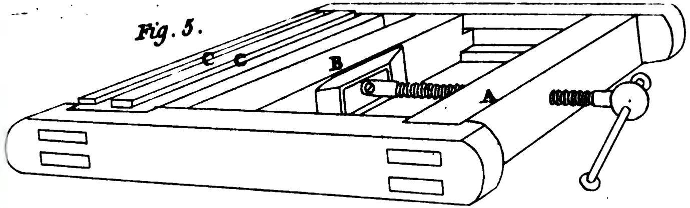


Fig. 5.

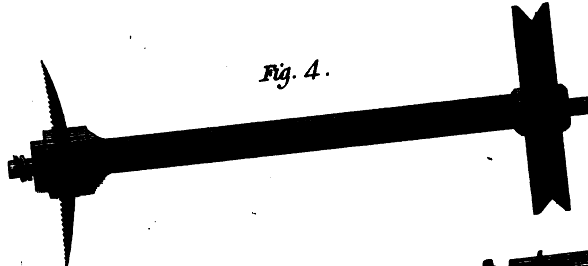


Fig. 4.

Fig. 3.

one more simple than the rest which must not be passed over in silence. It is that in which he proposes to decompose the sulphate of soda by charcoal alone; and which he has practised nearly two years, at the bleaching yard at Glaciere, near Paris; but at the same time he does not conceal that it is difficult, even for the most experienced (and no one is more so than himself), to ascertain the instant when it is proper to withdraw the matter from the fire. If too soon, the sulphate of soda is not decomposed, and there is but little free soda; if too late, the sulphur is burnt, and sulphate of soda is immediately regenerated; he says:

"Take 100 pounds of sulphate of soda, reduce it to a powder, and then mix it with 25 pounds of charcoal dust; put this mixture into a proper furnace, heat it at first until the roof be of a white heat; in an hour's time the matter inflames, and an hour and a half afterwards, the sulphur is formed; keep up the fire, and in about an hour the matter begins to melt; then weaken the fire, turn the matter often, move it from place to place, and when it is in a good pasty fusion, increase the fire suddenly to such a degree as to produce more fluidity; as soon as it begins to run upon the front of the stove the operation is finished: it is removed when cold, and carried to the store-house to be lixiviated as it is wanted."

This operation lasts four hours; the pasty fusion indicates the formation of the sulphur; but this phenomenon is preceded by several others.

1. When the mixture is well ignited, the charcoal begins to burn with a peculiar and vivid flame; at this period the matter must be frequently turned, in order to multiply the surfaces, and to favour the combustion; this lasts one hour.

2. To this flame succeeds another, which is sulphurous, short, and light, and covers the surface of the mass; this usually takes place an hour and a half after the first period.

3. An hour after the fusion has commenced, the fire is augmented, and an hour and a half after that succeeds the liquid fusion that denotes the completion of the operation.

The signs thus presented seem to denote a work easy to be conducted, but we must not deceive ourselves. Ribaucourt has practised it with advantage two years for bleaching; but the difficulty he found in distinguishing these epochs, and the slight variations which effect all the phenomena, obliged him to relinquish the process to seek for an agent by which he could separate the sulphur, and this agent he has found in iron.

There is reason to regret that this process is attended with so many difficulties, and that it is equally difficult to obviate them, for the sulphate of soda if once obtained in any way whatever, charcoal alone would terminate the operation. Ribaucourt has likewise decomposed sea-salt by the calx of lead.

"This mixture is formed of equal parts of muriate of soda and litharge, 100 of each; the litharge having been pulverised is ground with the salt, in portions of two pounds each, and three pounds of water. By degrees the litharge loses its colour, it becomes white, and in the end is entirely bleached. The matter at first absorbs little water, but according as it is beaten it takes a consistence which requires an additional quantity of water, in portions, and not all at once. When it has absorbed all the water, it acquires a pasty consistence. It is then put into jars to deposit, where it is left for 24 hours, care being taken to shake them from time to time. It is then of a very

very fine white." "The matter having acquired this degree of whiteness it is submitted to pressure; by which means it yields 120 pounds of ley of 21 degrees. 120 pounds of water is added to it; the mass is stirred, again pressed, and another ley is obtained of 41 degrees. Lastly, a third operation, with the same quantity of water, produces a ley of four degrees.

The whole of the water employed in the grinding is - - - - - - - - - - -	660 lb.
The whole of the liquor produced by pressure - - - - - - - - - - - - - -	480
The mean weight of which is - - - - - -	$12\frac{1}{2}$ deg.
The pressed residue when fresh weighs - -	$122\frac{1}{2}$ lb.
When dry - - - - - - - - - - - -	103 lb. 2 oz.

"The liquors are mixed together again, and evaporated. In the course of the operation a crust or pellicle is successively formed, which soon breaks, and falls to the bottom of the liquor. It is successively skimmed off, and the evaporation is continued to dryness. It is left to drain for 24 hours, and weighs 83 pounds 12 ounces.

"This salt does not resemble in its form the crystals of soda; it is aërated and caustic, and contains some muriate of soda. When exposed to the air, it effloresces, and whitens considerably; but, as its causticity prevents it from crystallizing, Ribaucourt heated it strongly in an iron pot. He next made a ley, and obtained a soda perfectly crystallized."

The sea-salt which is separated by the evaporation weighs 16 pounds 12 ounces, or nearly $\frac{1}{5}$. The residue may be reduced to lead, or converted into mineral yellow by fusion, whichever is most desirable.

This operation, says Ribaucourt, is like that in which the decomposition of sulphate of soda is effected by char-

coal, inasmuch as there are the same nicetíes to be noted, and the same difficulties to be surmounted.

This process is, as we see, the same as those of which we have before spoken; such, for example, as the greatest quantity of soda that he says he has decomposed. The marine-salt is here employed in equal parts with the litharge; and when the circumstances of the operation are well attended to, none of it escapes decomposition; whilst Chaptal, who puts but one quarter of muriate of soda, and Carny four-fifths, still find oxyd of lead uncombined in the residue. On the other hand, Ribaucourt grinds it as Arthur does, and this means may occasion a difference.

Martial vitriol has been proposed, with reason, as a very convenient method of effecting the decomposition of sea-salt; but this vitriol is only obtained by the decomposition of pyrites; and this decomposition always requires time, air, or fire, and often all three. It occurred to us, that it would greatly shorten the time, and diminish the expense, if it were possible to decompose sea-salt and pyrites, the one by the other, and to make Glauber salt all at one time. This we attempted, and perfectly succeeded in it.

We pursued this object with so much the more certainty, since it constantly appeared, that among the different agents proper for converting sea-salt into sulphate of soda, and for decomposing the latter, in order to separate the base, there have been none hitherto superior to iron, martial vitriol, or sulphate of iron, and chalk.

Decomposition of a Muriate of Soda by the agency of Martial Pyrites.

"We mixed together 10 pounds of pyrites, from the environs of Paris, and 4 pounds of muriate of soda. The whole,

whole, reduced to a powder, was put into an iron vessel; and this mixture was calcined for 60 hours *. Whilst this calcination lasted, it exhaled much sulphurous and muriatic acid; the mass when withdrawn from the fire was pulverulent; it had the appearance of a brown oxid of iron, approaching to red; and it had lost 3 pounds 4 ounces of its weight. This matter was washed in warm water, and the ley yielded 4 pounds 8 ounces of sulphate of soda. The mother-water, evaporated to dryness, left a saline mass, incrystallizable, that weighed 14 ounces. This was a mixture of muriate of soda, not decomposed, of sulphate of soda, and of muriate of iron. The residue of the lixiviation, remaining on the filter and dried, is an oxid of iron, of a brown colour, and weighs 6 pounds 12 ounces; but, as in heating this oxid we observed that still much sulphurous acid was disengaged from it, we were convinced that the quantity of 10 pounds of pyrites would decompose a greater quantity of sea-salt than the 4 pounds that we had put into this mixture." We also observe that this oxid will, in this state, serve immediately, by the help of charcoal, to terminate the operation; in short, to decompose the sulphate of soda, and set free its base. We soon perceived how much the use of pyrites would tend to œconomise the time and expense, and to simplify the process; and farther, that charcoal seasonably added abridges the time of calcination.

We have besides proved, that this mixture of pyrites, muriate of soda, and charcoal, exhibits during the calcination the phenomena of pyrophoric combustion; that pit-coal is as proper for this operation as charcoal; lastly, that turf, reduced to a powder, is better than either; and that, in cases where the one or the other is used as an

* Without doubt this space of time might be much shortened, as will be seen farther on.

agent,

agent, there will be a considerable disengagement of sulphate and muriate of ammonia, since these two combustible substances equally furnish volatile alkali, which vegetable charcoal does not.

The products of this last experiment, reduced to the quintal, are as follows:

	lb.	oz.
Martial pyrites - - - - - - - - - - -	100	0
Muriate of soda - - - - - - - - - - -	40	0
	140	0
The calcination reduced it to - - - - - - -	107	8
Sulphate of soda obtained from the ley - - -	45	0

Saline mass of mother water dried, containing muriate of soda not decomposed, sulphate of soda incrystallisable, and muriate of iron 11 pounds 14 ounces. Rough oxid of iron, the residue of the lixiviation, capable of serving, with the addition of charcoal, to decompose sulphate of soda, and to convert it into soda, according to the process of Alban, 67 pounds 8 ounces.

According to the calculation of Kirwan, which allows to the quintal of sulphate of soda 22 pounds of pure caustic soda, without either acid gas or water of crystallisation, the 45 pounds of sulphate of soda obtained above contain nearly 10 pounds of pure caustic soda; from whence it results, that 1000 pounds of pyrites, and 400 pounds of sea-salt, would produce about 450 pounds of sulphate of soda, or 100 pounds of pure and caustic soda.

This calculation is very different from Bergman's. According to him 100 pounds of pure soda is equivalent to 500 pounds of carbonate of soda crystallised, with all the water of crystallisation; and 500 pounds of crystals

of

of soda, saturated with air and water, containing 20 *per cent.* of pure and caustic alkali, equal - - 100 lb.

Water of crystallisation at 64 *per cent.* -	320
Carbonic acid 16 *per cent.* - - - - - -	80
Total	500

Combustion of Martial Pyrites and Sea-Salt, by the agency of Pit-Coal.

"Ten pounds of martial pyrites, and 32 of the pit-coal of Forez, coarsely bruised, were mixed together. They were kneaded with water holding six pounds of sea-salt in solution. The mixture thus formed was worked into balls, and burnt upon iron bars in a reverberating furnace, by the help of a little lighted charcoal placed under the balls.

"The combustion was at first vivid and inflamed; afterwards it abated; but the matter continued to burn with a light blue flame, accompanied with an abundant disengagement of the vapours of muriatic and sulphurous acid. The incineration was completed in 13 hours.

"The ashes were of a reddish grey. They were lixiviated; and by evaporation six pounds of crystallised sulphate of soda were obtained. The residue, when dried, and calcined afresh, disengaged much sulphurous acid; which proves what we have before observed, that this quantity of pyrites would be sufficient to decompose a greater quantity of sea-salt, and consequently to furnish more sulphate of soda.

"The sides of the furnace, and especially the dome and the chimney, were covered with a soot containing muriate of ammonia; which convinced us, that by placing between the furnace and the chimney a chamber similar to that in the manufactory at St. Denis, we might, without

without any other expense, retain a considerable quantity of salt; which would be a farther advantage; and so much the more since pit-coal, as we have before mentioned, is still more favourable to the decomposition of sulphate of soda by ferruginous oxyds than charcoal.

Products of this Operation to the Quintal.

	lb.
Martial pyrites - - - - - - -	100
Pit-coal from Forez - - - -	320
Sea-salt - - - - - - - - -	60
Total	480

The substances, burnt and reduced to ashes, yielded, by lexivation, sulphate of soda in crystals 60 pounds. These 60 pounds of crystallised sulphate of soda contain, according to Kirwan, pure caustic soda 13 pounds 3 ounces. Which, according to Bergman, are equivalent to 65 pounds 15 ounces of crystallised soda, saturated with carbonic acid, and combined with the water of crystallisation.

Combustion of Pyrites with Turf and Sea-salt.

" 100 pounds of pyrites and 30 pounds of turf were well mixed together, and worked into a paste with a solution of 6 pounds and a half of sea-salt. This paste was formed into balls; which, when dried, were placed in a reverberating furnace. After two or three pieces of lighted charcoal had been put upon the grate, the fire lasted for 30 hours. This combustion was slow, and had a pyrophoric appearance. The incineration was completed; the ashes were washed, and the ley evaporated and concentrated. It furnished seven pounds of crystallised

lised sulphate of soda; and the mother-water, when evaporated to dryness, furnished 1 pound 11 ounces of muriate of iron, and a portion of sulphate of soda, which the iron had prevented from crystallising.

"The residue of the leys was dried, and appeared of a brown colour, approaching to red. It was calcined in a crucible, and still disengaged a great quantity of sulphurous acid vapour; which confirms what we have already said, that in these operations the quantity of sea-salt that is taken into them is much less than the vitriol of iron, or pyrites burnt with pit-coal, or with turf, is capable of decomposing, and converting into sulphate of soda."

After this latter combustion a greater quantity of soot, of muriate and sulphate of ammonia, were found than in the preceding operation; and this would be a reason, wherever one of these two processes is used, for adapting to the furnace of combustion a chamber for the purpose of receiving and condensing these vapours. It is by collecting all the products of the operations, as far as is possible, and by a strict attention to prevent even the slightest waste, that great undertakings are rendered prosperous.

By reducing to the quintal the quantities of burnt matter, and of the product of this last operation, we have the following view of it:

	lb.
Martial pyrites in powder - -	100
Turf - - - - - - - - - - -	300
Sea-salt - - - - - - - - - -	65
	465

yield 70 pounds of crystallised sulphate of soda, without reckoning what remains of this salt, combined with the

 muriate

muriate of iron, in the mother-waters of the crystallisation. We may add besides, that which the sea-salt would yield, that may be added to the mixture, beyond what had been originally taken. We wished to have ascertained as nearly as possible what quantity of pyrites would decompose a certain quantity of sea-salt; but the experiments for that purpose would have required more time than we could afford. It is sufficient for our present object to announce that the given quantities of pyrites are capable of effecting a much larger decomposition. We have had occasion to make the same remark on the other processes described in this report, where the amount of the agents often did not appear to exceed that of the materials which yielded the products.

It has likewise been proposed to effect the decomposition of muriate of soda in the humid way by the aid of sulphate of iron; we attempted this method, but did not succeed well; neither did Blavier, who made the same attempt; and without denying its possibility, we think that it cannot obtain a preference over those which are so well effected by fire. Yet we would advise such well-informed men as may be inclined to vary their processes, from the examples of Lorgna and Carny, not to be discouraged, since their labours would be amply compensated, should they chance to succeed.

Lastly, we attempted to employ the dross of iron which is thrown away by locksmiths and blacksmiths; and this agent, reduced to a powder, succeeded perfectly. Indeed, this material may be said to be entirely composed of iron, for, we have seen it when collected promiscuously, contain 800 in a 1000 parts, perfectly attractable by the magnet; part of it is even malleable, and yields to the hammer.

Recapitulation.

Recapitulation.

It is necessary to make succinct recapitulation of these different methods, in order to point out those that may be best adapted or employed in all places and all circumstances, without rejecting those which which can only be executed with advantage in particular situations.

It appears to us, that Leblanc's process by the agency of chalk may be most generally adopted, because this material is everywhere to be found; it has, besides, this advantage, that it does not prevent the soda from being used in commerce in a rough state; that it resembles more particularly that which is procured from abroad, and to which we have been so long accustomed; indeed, it may be used immediately and without previous washing, in soap-making, common glass-making, and washing; add to which, this process being executed with sulphuric acid, the muriatic acid that results from it is combined in its pure state, for making sal ammoniac; whereas, with the agency of pyrites, the disengagement of volatile sulphurous acid, which is effected simultaneously with the muriatic acid, would tend to form ammoniacal sulphate in the chamber, and would much injure the purity of the true sal ammoniac, which in that case would require a fresh process in order to purify it.

But these advantages will be amply compensated in the processes that are executed by the agency of vitriol, pyrites, turf, &c. It appears to us that, all circumstances equal, they will yield a greater quantity of carbonate of soda, owing to the greater affinity that the sulphur has with iron than with chalk; or, this greater affinity cannot but tend to hasten and facilitate the separation of this substance, and to favour besides the disengagement of

the soda: such is in fact the comparison of the results that we have obtained.

But it will also be indispensible, in every process, to make in the manufactories themselves a ley of these rough sodas, in order to separate from them all the oxid of iron; for in whatever state it may be found, it is equally impossible to suffer it to enter into any composition without considerable injury; and we are of opinion, that this lixiviation of rough sodas should be made without exception in all soda manufactories, whatever may be the method of their preparations; and if it be considered what an infinite variety there is in those of commerce, relatively to the quantity of alkali they contain, the facility and impunity with which the merchants deceive the bleachers, and most of those who buy it retail, the useless expence and even injury occasioned by the incumbrance of all the residues that must be separated, according to the usual custom, no one will disagree with us.

It would be impossible to fix on all the places in the republic where soda may be made. The different materials capable of serving as agents for the decomposition of sea-salt, are to be found almost everywhere; and this salt is generally so plentiful and common, that there are few places in France where soda may not be fabricated, if not as a grand object of commerce, at least to satisfy any local demand.

An accident to which the printing of periodical works is liable, prevented the Editors from noticing in due time several inaccuracies in the first part of this paper, inserted in the two last half-sheets of No. 57, in which it is printed.

printed.* Our readers will please to correct them as follows.

Page 231, line 19, *for* fuel *read* matter.

Ibid. line 20, *for* by which to withdraw the fire, *read* to withdraw it from the fire.

Page 232, line 19, *after* chimneys and, *instead of* which serves to interrupt or leave free the, *read* with which is preserved a.

Ibid. line 24, *instead of* the passage is left free, *read* the passage of the chimney is left free.

Ibid. last line, *for* which is composed, *read* produced.

Page 233, lines 8 and 9, *for* it disengaged the principles of this new combination, *read* as the principles of this new combination are disengaged.

Page 235, line 1, *for* fry by, *read* combine with.

Ibid. line 17, *for* which forms, *read* forming.

Ibid. line 19, *for* with which it is saturated, *read* with which it saturates itself.

Ibid. line 30, *for* entirely abandons it and, *read* makes it abandon.

Page 236, line 6, *for* concentrates, *read* is concentrated.

Page 239, line 9, *after* of, *insert* the.

Experiments on Molybdena. *By* M. BUCHOLTZ.

From the GERMAN CHEMICAL JOURNAL of KLAPROTH, CRELL, &c.

IT is about 26 years ago that Scheele discovered in Molybdena (the sulphuret of Molybdena) a peculiar metallic substance, several of the properties of which he described, as well as its action upon several other substances.

Several

Several able chemists, as Pelletier, Heyer, Ilsemann, Richter, Hielm, Klaproth, Ruprecht, &c. have since made enquiries upon this subject; but the knowledge which we have derived from their labours, is by no means proportionate to the number of chemists who have investigated it, or the length of time which has elapsed since Scheele's discovery. To be convinced of these, one need only cast a glance upon the different elementary books of chemistry which have been published. Who must not be surprized to see the chemists still express doubts respecting the composition of molybdena, such as it is found in nature? Some consider it as a sulphuret in which the molybdena is in a metallic state; others assert that they have not found it to contain the smallest particle of sulphur, and consider the molybdena, as found in nature, to be native metallic molybdena. However, the mere smell is sufficient to convince us of the presence of sulphur in it. Let laminæ of the purest molybdena be heated to redness, and the sulphurous odour which exhales from them will be sufficient to convince any one of the presence of sulphur who is not entirely destitute of the sense of smelling. Moreover, it has not yet been ascertained in what proportion the oxygen is combined with the metal in the molybdic acid, which acid however has been known for so great a length of time. The want of positive information respecting these points, led me to believe that, by undertaking a series of experiments upon molybdena, I should perform an useful work, which would contribute to augment and rectify our knowledge respecting the substance. I owe to the goodness of my friend M. Haberlé the considerable quantity of molybdena which enabled me to make these experiments.

The first thing which I thought it necessary to do, was to ascertain, beyond the possibility of doubt, the presence

sence of the sulphur, and to determine its quantity. It appeared to me that the best method I could employ for this purpose, would be to oxygenate the sulphur and the molybdena, and to separate, with the acid of barytes, the sulphuric acid that should be formed; but it was necessary that I should previously ascertain whether the molybdic acid which likewise forms with barytes a salt of little solubility, might not occasion some error in this determination.

I. *Experiments to determine the composition of the natural sulphurated Molybdena.*

Experiment 1. Twenty-five grains of very pure and well-selected laminæ of molybdena were reduced to a very fine powder, and heated briskly in a small glass matrass. No sulphur was disengaged: the matrass, when cooled, contained a slight vapour of sulphurous acid, and the red molybdena had scarcely lost half a grain of its weight. This experiment proved therefore: 1. That the molybdena did not contain sulphur in excess. 2. That the heat employed was not sufficient to separate the sulphur from it. 3. That there was no oxygen combined with it.

Experiment 2. The molybdena of the preceding experiment was put into half an ounce of pure nitric acid, of which the specific weight was 1,22; and the whole was boiled upon a sand-bath. The acid attacked the molybdena pretty briskly, but not so much so as I had expected. In order to accelerate the operation, and to prevent the sulphur from passing into the state of sulphurous acid, I added 1½ drachm of pure muriatic acid (of 1,135) and 1 drachm of nitric acid. After an hour's boiling, the whole was converted into a homogeneous mass

of

of a milky whiteness. This I mixed with eight times its weight of water, filtrated and separated the sulphuric acid that was formed, by washing sufficiently the residuum and the filtre. Into the liquor that had passed through the filtre, I poured solution of muriate of barytes. A precipitate was formed, which, being carefully collected, dried, and heated to redness, weighed 72 grains, and which comported itself like pure sulphate of barytes. No molybdate of barytes was precipitated. In order to ascertain the circumstances under which this precipitation was possible, I made the following experiment.

Experiment 3. Five grains of molybdic acid were put into two ounces of distilled water; to these were added 20 drops of muriatic acid, of the same strength as that before employed. This mixture was boiled for half an hour, and filtrated. The liquor had a very harsh metallic taste; the solution of muriate of barytes did not render it turbid, whereas a small quantity of sulphuric acid immediately produced this effect.

Experiment 4. Five grains of molybdic acid, and 20 grains of pure liquid ammoniac, were put into two ounces of water; the mixture was agitated till a perfect solution was effected, and a solution of muriate of barytes was added. Immediately an abundant flakey precipitate was produced, which was dissolved by the addition of some drops of muriatic, or of nitric acid, with the aid of agitation.

These experiments shew, 1, that no insoluble molybdate of barytes was formed, until the molybdic salts, with a base of barytes, were neutralized, but not whilst any free muriatic or nitric acid was present. 2. That the molybdena contained a large quantity of sulphur; for the 72 grains of sulphate of barytes, which were obtained

from

from 85 grains of molybdena in the second experiment, represent nearly 24 grains of dry sulphuric acid, which indicates a content of 102 grains of sulphur, or of 40,8 to 100 of molybdena. These experiments being made, it was now possible to proceed to a more accurate analysis.

Experiment 5. A hundred grains of laminæ of molybdena were put into a retort, with 6 drachms of pure muriatic acid, weighing 1,135, and $2\frac{1}{2}$ of nitric acid, equally pure, weighing 1,22. The distillation was performed with a moderate heat, upon a sand-bath. At the end of an hour's ebullition, almost the whole of the liquor had passed into the receiver; what remained in the retort was white, with the exception of some grey flakes. The liquor was poured again into the retort, half an ounce of fresh nitric acid was added, and the grey flakes disappeared when about a third of the distillation was compleated. The liquor which had passed over, contained neither sulphuric nor sulphurous acid. The white mass was mixed with six ounces of water; the mixture was filtrated, and the residuum was washed several times, with every possible precaution. In order to assure myself, that in precipitating the sulphate of barytes, which was about to be prepared, there would not at the same time be precipitated any molybdate of barytes, I added still two drachms of pure muriatic acid to the liquor, which contained only a small quantity of molybdic acid in solution; this being done, I added solution of very pure muriate of barytes, and sulphate of barytes was precipitated. I filtrated through a filtre, which I had weighed; I put the residuum into 8 ounces of water, containing 2 drachms of muriatic acid, and stirred them together; then I filtrated again, and washed the residuum. After having been heated to redness, it weighed 234 grains, to which 6

grains are still to be added, as the filtre, when well dried, was found to have increased by so much in weight. As 100 grains of sulphate of barytes contain 32,5 of sulphuric acid, we have 94,25 grs. of sulphuric acid; and as according my experiments, 100 grains of sulphuric acid contain 42,5 grains of sulphur, it follows that the quantity of sulphur contained in the 100 grains of sulphurated molybdena is 40,56, a result which differs very little from that indicated by the second experiment. This agreement rendered a repetition of this analysis unnecessary; however, the circumstances of which I shall speak hereafter, induced me to perform a new one. I took 100 grains of powder of molybdena, which I put into a mixture of 3 ounces of nitric acid, and one ounce of muriatic, and treated them as before, with only this difference, that the larger quantity of acid which I had employed at first, rendered it unnecessary to pour again into the retort what had passed into the receiver. The sulphate of barytes obtained weighed 288 grains, which, according to the preceding computations, contain 93,6 grains of sulphuric acid and 39,78 grs. of sulphur. Taking a mean term between this result and the preceding, we may conclude, that the sulphuret of molybdena contains in 100 parts,

Sulphur - - - - - - - - - -	40
Metallic molybdena - - - -	60

Experiment 6. A hundred grains of sulphurated molybdena, dissolved as before, and distilled to dryness, were put into two ounces of pure liquid ammoniac, which was diluted with an equal quantity of water: they were agitated in it, and at the end of a quarter of an hour, the whole was dissolved, with the exception of some yellowish flakes, which collected upon the filtre, and heated to redness, did not weigh altogether a grain. By

boiling

boiling in muriatic acid, they were decomposed, and gave 0,75 grs. of silex, and 0,25 grs. of oxyd of iron. This small quantity leadsme to think, that these two substances are only accidental in molybdena, and that they were mechanically combined with the specimens analysed.

I endeavoured to procure, from the subsequent experiments, a certain quantity of molybdic acid. I employed the processes which I have indicated in another work, and of which I shall give a short account.

II. *Process for obtaining Molybdic Acid.*

I took 11,5 ounces of molybdena, from which the quartz that adhered to it had been almost entirely separated. These I put into a large crucible, which I placed obliquely over the fire. At first I applied a heat sufficiently strong to set fire to the sulphur, which I afterwards diminished, and roasted the matter, stirring it from time to time with an iron spatula. A large quantity of sulphurous acid was disengaged, and the mass to be roasted covered itself entirely with a crust of the purest molybdic acid, which was of a lemon yellow colour whilst over the fire, but assumed the most beautiful silvery whiteness when cooled. With some caution and trouble, it would have been possible to change thus the whole of the matter into molybdic acid: but, as this would have required much time and attention, I concluded the operation, when I saw that the greater part of the sulphur had been volatilized, that there was formed a large quantity of molybdic acid, and that on leaving it exposed to a less intense heat, the mass began to agglutinate, and even to become again fluid at the sides of the crucible. I obtained by this operation 8,5 ounces of a grey brilliant matter, entirely crystalliue, which, when pulverized,

 was

was of a whitish grey. There remained half an ounce of it adhering to the sides of the crucible, from which it was difficult to detach it.

The pure molybdic acid is separated from the roasted mass, by heating it with water, adding carbonate of soda, till no more effervescence takes place, and afterwards boiling it with a small excess of soda; the separation is also effected by digesting the mass with pure fluid ammoniac; the heterogeneous parts, such as the quartz and the oxyde of iron, remain undissolved. Nitric acid is poured into the neutralised liquid, and the molybdic acid is precipitated. We may also decompose the molybdate of ammoniac by fire, and we then obtain, according to the circumstances, sometimes molybdic acid, sometimes molybden in the metallic state, or at least approaching to the metallic state.

I employed the latter means (ammoniac) as being the most advantageous. Former experiments had shewn me, that 3 parts of pure liquid ammoniac, weighing 0,97, dissolve one part of molybdic acid reduced to very fine powder, and separate it from all the impurities with which it may be mixed; I therefore pulverized the product of the preceding roasting; I put it, with ammoniac, into a well-stopped bottle, and let it digest for twelve hours, stirring it from time to time. The acid disappeared, and there remained two ounces of heterogeneous parts, which still contained some small quantity of undecomposed molybdena. This residuum was boiled with two ounces of ordinary nitric acid; the molybdena was easily changed into acid, which was obtained entirely pure, by means of ammoniac.

The ammoniacal liquor in which the roasted mass had been dissolved became a little turbid at the end of five hours, and assumed a yellow-ochre colour. Five days after,

after, the matter which produced the turbidity was deposited, and it comported itself as oxyd of iron. A part of the limpid solution was evaporated to dryness, and a part of the residue was heated to redness, in order to obtain from it the pure molybdic acid, as I had formerly done with a smaller quantity; but I was disappointed in my expectation. At first the molybdate of ammoniac became blue, and at last it assumed throughout, even in its interior, a metallic aspect; its colour was changed from blue to a coppery redness, and it had an appearance similar to that of some products which I had formerly obtained, and which every thing indicated to be molybdena in the metallic or almost metallic state. The mass became oxydated anew at the surface: it was more agglutinated in the places where the heat had been more intense.

III. *Experiments to determine the most advantageous Method of reducing Molybdena to the metallic State.*

Exp. 7 and 8. Having obtained, by the process which I have just indicated, a mass which I had every reason to believe was in the metallic state before other experiments had given me fresh insight into its nature, I resolved to employ the disoxygenating action of ammoniac, in order to obtain the molybden in the metallic state. For this purpose, I took six ounces of liquid molybdate of ammoniac, which I evaporated to dryness (during the evaporation it exhaled a smell very similar to that of vanilla); the saline residuum was put and pressed in a small glass, of a proper form, and covered with a layer of charcoal powder. This glass was placed in a crucible, its sides surrounded with sand, and the whole was put upon the fire. When the ammoniac was volatilized, the glass was closed with a stopper of chalk, the fire was briskly augmented, and the crucible kept for half an hour exposed to

a strong

a strong red heat, which caused the glass to melt. After cooling, I found a mass of considerable compactness, easily pulverizable, of a copper colour, inclining in some parts to a blue, of a metallic lustre, and presenting crystalline laminæ. It weighed three drachms.

In order to see whether this mass might not be fused into a button by a more intense heat, I pounded it (the powder was of a violet-colour, inclining to a copper-red); put it into a coated crucible, and pressed it strongly down, covered it with a layer of charcoal about a finger's breadth in thickness, closed the crucible well, and kept it for half an hour in a forging heat, in which it was heated to whiteness. After it had cooled, I found the mass agglutinated in the places where it had been the most exposed to the action of the fire; but in the middle it was pulverulent, and had preserved its colour.

Exp. 9 and 10. Wishing to repeat the preceding experiments with a more intense heat, I put molybdate of ammoniac into a Hessian crucible. After the volatilization of the ammoniac by a moderate heat, I covered the mass with a layer of charcoal-powder, and closed the crucible. I urged the fire to whiteness, and kept the crucible in this state for half an hour. After cooling, I found a compact mass of a violet-brown colour, the lower part of which, that which was in contact with the bottom of the crucible, and which consequently had experienced the strongest degree of heat, presented a sufficient consistence. It could not be reduced to powder without difficulty. This powder was of a violet colour, and appeared to consist of a multitude of small crystalline filaments, having a metallic brilliancy. The fissures which traversed the mass in every direction, presented at their sides a great quantity of larger filaments, also of a violet colour, and of a very beautiful metallic lustre; even the exterior

exterior of the mass was in a great part covered with filaments, though of smaller size, and exhibited an agreeable play of colours. The upper part, which had been in contact with the charcoal powder, gave some reflections of an indigo-blue. The outside of the crucible was spotted with green in several places.

Several circumstances of the preceding experiment indicated that the mass would have become softer and more compact if it had been exposed to the action of a more violent fire. I therefore took an equal quantity of molybdate of ammoniac, and exposed it for the space of an hour to the action of the most intense heat. After cooling I found a mass weighing five drachms, perfectly similar to the preceding; but which however appeared to be a little more compact, and the fissures were filled with more crystalline filaments, and in larger quantity. These filaments, when viewed through a magnifying glass, and exposed to a strong light, resemble polished similor. The largest of them have even this appearance to the naked eye.

As the masses obtained in the four preceding experiments had a specific weight from 4,5 to 5,67, according to their different densities, and as this is the specific weight which several authors assign to the metallic molybdena; as, moreover, when heated in contact with the air, or with nitric acid (which produces a disengagement of oxygen gas), they yielded molybdic acid; and, finally, as they had a metallic aspect, I was led to regard them as *reguli* of molybdena, and that the rather as no person had hitherto spoken of such an *oxyd*. But subsequent observations have shewn me that these masses were molybdena in a particular state of oxydation; and that by the processes which I had till then employed it would not be possible for me to obtain the molybdena in the pure metallic state. I was therefore

fore necessitated to attempt the reduction by other means.

Exp. 11, 12, and 13. I took four drachms of molybdate of ammoniac, similar to the two masses obtained in the preceding experiments. I pulverized, and mixed them with olive oil, to the consistence of a thick paste. I heated in a crucible till the oil was burnt; then I pressed what remained, and covered it with a layer of pulverized charcoal; over which I sprinkled a small quantity of powdered chalk. I then placed another crucible over it, and, urging the fire to the most intense incandescense, I kept it for five quarters of an hour in this state. After the combustion of the oil the mass was pulverulent, of a dark blue colour, approaching nearly to black, and in some parts violet. After the action of the intense heat to which it had been exposed, it was entirely of an ash-grey colour, and formed a mass of an earthy appearance, the parts of which had very little mutual adhesion. The part in contact with the crucible presented scarcely the slightest indication of fusion. When put into nitric acid, it produced a more considerable effervescence than the products of the preceding experiments. The solution thus produced was at first reddish, and afterwards assumed a milky whiteness. I added concentrated muriatic acid to it, and boiled to dryness, without any sensible solution taking place. These circumstances led me to believe that the molybdena was entirely reduced, and that nothing was wanting but the union of its particles into a button.

Wishing to obtain such a button, I pulverized the mass obtained in the preceding experiment, and which weighed 3½ drachms. I pressed it into a small crucible, and exposed it again, for the space of an hour and a half, to the most violent forging heat. This heat was so intense that the whole surface was vitrified, and iron was melted and

and burnt in three minutes. After cooling, the layer of charcoal powder, which had been put at the top, had scarcely undergone any alteration. The molybdena had preserved almost completely the same form which it had before; it was of an ash-grey colour, its particles were but feebly agglutinated, and no trace of fusion could be perceived, not even in the part that had adhered to the sides of the crucible. Its weight was, as before, 3½ drachms.

I took the same mass the third time, pulverized it with six grains of charcoal, and exposed it again for an hour and a half to a forging heat, which I endeavoured to render as intense as possible. After cooling, the mass had the same ash-colour as before; when the crucible was inverted, it fell from it without breaking; it had a little degree of consistence, but nevertheless it was friable between the fingers, and easily pulverizable. No trace of fusion could be discovered in the interior of the crucible. The weight had been diminished by six grains, on account of what had remained adhering to the crucible. When the mass was immersed in water, it imbibed the liquid with avidity into its interstices.

Exp. 14 and 15. In order to ascertain whether the molybdic acid could be reduced by the mere action of fire, without being mixed with carbonaceous matters, I took a piece of acid which had been fused, and which weighed 55 grains. I placed it in the middle of powdered charcoal, in a crucible, and exposed it for an hour and a half to the same degree of fire as in the preceding experiment. I obtained a pasty mass, which had not more consistence than that of Experiments 12 and 13. It was likewise of an ash-grey colour, and had lost 18 grains of its weight, which amounts to 32,73 in 100. It comported itself in nitric acid like the masses obtained in the preced-

ing experiments. 270 grains of the matter obtained from the molybdate of ammoniac roasted in Experiments 9 and 10, treated in the same manner, and kept for a quarter of an hour in incandescence, gave a product similar to that of Experiments 12 and 13. They had experienced a loss of 78 grains, which amounts to 28,89 *per cent.*

In a second experiment, 464 grains of the violet-brown oxid, having been kept for only half an hour in a moderate strong red heat, there resulted a mass which was but imperfectly reduced; the interior was in no wise changed; only the surface was grey. Placed again upon the fire, and kept for half an hour in a state of incandescence, it was entirely reduced, and lost 74 grains, which amounts to 28,03 per cent. Hence it follows that the substance obtained from the molybdate of ammoniac is very far from being in the metallic state.

These experiments shew that the oxygen may be separated from the molybdena by the mere action of fire and the contact of charcoal. They prove that the reduction of the oxyd and of the acid of molybdena may be effected without much difficulty. It remained to be ascertained whether this reduction could be performed upon larger quantities, and whether the molybdena might not be obtained in a button.

Experiments 16 and 17. I took ten drachms of molybdate of ammoniac, which having put into a glass, I placed in a crucible, and heated to redness for half an hour. I obtained an ounce of violet-brown oxyd forming a mass; this mass I placed in a crucible, surrounded it with pulverized charcoal, and kept it exposed for an hour to the most intense forging heat. I obtained a metallic mass, the parts of which were more or less interspersed with bubbles and more or less tenacious; however, in no part

was

was the tenacity such that the matter could not be reduced to powder by striking upon it. Its external surface was of an ash-grey colour; in its interior, and even at the surface where cavities and hollows had formed, it had a true metallic lustre and a silvery blue cast. The parts which had this lustre being triturated and pounded in a porcelain mortar, extended themselves a little under the pestle, which increased their brilliancy; but by continuing the operation they were reduced to a grey powder. Their hardness previous to the trituration was superior to that of silver at 0,750, for they scratched it.

In order to obtain this matter in small fused parts, I pounded six drachms of it, and pressing them strongly into a coated crucible, I exposed them for an hour and a half to the most violent forging heat. After cooling, I found that the volume of the mass was diminished by one-fourth, and that it had become agglutinated. I could not separate it from the crucible without breaking the latter; in the parts which had been in contact with the sides and the bottom, it had a considerable tenacity; but this was not the case with the surface. It could not however be said that it had in any part been actually fused; its parts were only agglutinated by an incipient fusion. It presented throughout a large quantity of filaments, which were of a silvery whiteness and a metallic lustre; when crushed upon glass or porcelain, they assumed a brilliancy intermediate between that of tin and that of silver; but which disappeared at the end of 12 or 15 minutes. At the bottom of the crucible were found small particles of molybdena, of the size of pins heads, and which had evidently run. They had a perfectly metallic lustre and a silvery whiteness, like that of the filaments just mentioned. The lower half of the mass of metallic molyb-

den, having been triturated with a porcelain pestle, likewise assumed the same lustre *.

Though the molybdena had here all the properties which characterize the metals—the lustre, the compactness, and even the malleability, though but in a slight degree; yet I could not obtain a well fused metallic grain, by exposing afresh a piece of the mass obtained in the former experiment, weighing 40 grains, to the most violent forging fire for the space of two hours. An experiment which I afterwards made upon two ounces of brown oxid, gave me a more fortunate result than those which I had till then obtained. I kept this oxid exposed to the most violent and best sustained fire, but only for the space of an hour; and though the whole mass was not fused into a button, yet in some parts there were seen portions from one to two drachms in weight, almost completely fused, having a spherical surface, a white metallic lustre, and a much stronger consistence than in the masses which I had till then obtained. When these metallic portions were rubbed against a very smooth piece of porcelain, they assumed a lustre hardly to be distinguished from that of silver. I must also remark that this lustre remained for several days, whereas in my other experi-

* Ruprecht appears to have observed something of a similar kind. He says, that in attempting to reduce molybdena, he had obtained small metallic grains, the smallest of which, had the appearance of silver, and that the sides of the crucible exhibited an incrustation of the same colour: however, he does not venture to assert that these grains were entirely metallic; for others were seen, which were either of a whitish grey, or of a reddish or bluish colour. The sequel of this memoir, and what has already been said, shews that these coloured grains belong to the oxyd of which we have made mention. Hielm, seeing that molybdena communicates to other metals a lighter colour, concludes that its own colour is white; a conclusion which is confirmed by my experiments.

ments

ments it did not continue an entire hour; probably in consequence of the humidity of the air.

From the experiments hitherto recorded, we may conclude:

1. That the fire, in decomposing the molybdate of ammoniac, causes the acid to pass, by virtue of the disoxygenating action of the ammoniac, into a less degree of oxygenation, and gives rise to a particular oxid, of which we have mentioned some of the external characters, in recording the Experiments 11, 12, and 13.

2. That the oxyd and the acid of molybdena are completely reduced by the mere action of fire, when they are placed in the middle of pulverized charcoal, and that the metal then appears of an ash-grey colour; but that this metal being difficult of fusion, it is necessary to employ the most intense degree of heat, in order to obtain a more compact metallic button, the possibility of which is placed beyond all doubt by the experiments which we have related.

IV. *Determination of the specific Weight of Molybdena.*

The property possessed by the masses of molybdena which I had obtained in the metallic state, of imbibing water when immersed in it, renders the accurate determination of their specific weight very difficult. In the three experiments which I made upon this subject, I suspended the masses by a hair to one of the arms of a very exact balance, and in order to expel the air as much as possible, I boiled these masses for a quarter of an hour in distilled water, after which I operated in a medium temperature.

The first experiment gave a specific weight of 8,636; the second of 8,490, and the third of 8,615; so that we shall not deviate very far from the truth if we reckon this weight

weight at the mean term of 8,611. (?) The result, it is true, differs much from that indicated by some writers, who fix this weight at 4,5, and 6,5. Hielm stated 7,5, as the *maximum*, but it is probable that the masses from which these determinations were taken, were not pure, that they were in part oxidated or filled with bubbles, which must have given to Hielm, Ruprecht, and Heidenger a specific weight less than the real one.

V. *Determination of the Proportion of the Oxygene to the Metal in the Molybdic Acid.*

Experiment 18. The knowledge of the quantity of metal contained in the natural sulphuret of molybdena, furnishes a commodious means of determining this proportion. For this purpose, I took a hundred grains of select laminæ of molybdena, which I put into a small crucible with some acid, as has been mentioned above, and distilled to dryness. Towards the end of the operation, sulphuric acid was disengaged in heavy grey vapours. In order entirely to expel this acid, I cautiously broke the crucible, and put the pieces into a small glass, which I placed upon the sand-bath in a crucible, and heated to redness for half an hour, whereby the whole of the sulphuric acid was volatilized, and the molybdic acid remained pure in the form of small crystals, of a yellowish white colour inclining to grey. This residuum weighed ninety grains. The fragments of glass were weighed, carefully washed, and weighed again, when they were found to have lost a grain. Thus the hundred grains of sulphuret of molybdena had yielded ninety-one grains of molybdic acid. Admitting, as we have already done, sixty parts of metal in the sulphuret, the proportion of the metal to the oxygene in the molybdic acid will be sixty

sixty to thirty-one, or 100 to 51,67. Thus a hundred parts of acid contain 34,06 of oxygene.

Experiment 19. Wishing to prove this point by a synthetical experiment, I took some of the matter obtained in the decomposition of the molybdate of ammoniac, by the action of fire, which I then considered as molybdena in the metallic state, and endeavoured to oxygenate it. When I had poured upon it nitric acid, of 1,22 specific gravity, a brisk effervescence immediately took place, which continued for some time, without requiring any application of heat; but when I dried the oxygenated mass, it was suddenly thrown out of the vessel, and a loss was occasioned which prevented me from continuing the experiment. I repeated the operation, employing a very long glass, in order therein to dry and fuse the oxygenated mass. A hundred grains of oxyd, treated with ten drachms of nitric acid, gave a radiated mass, which weighed exactly 109 grains. If we add a grain for what might have remained adhering to the vessels employed, we shall have 110 grains of acid, for 100 grains of oxyd.

This result differed so widely from the preceding, that I plainly saw, that either the matter which I had taken for molybdena in the metallic state, was not yet in that state, or that I had deceived myself in the determination of the content of sulphur, and in that of the oxygene, which the natural sulphurated molybdena is capable of absorbing. I therefore resolved to repeat my experiments.

I have already given the result of the second operation which I performed, in order to ascertain the quantity of sulphur contained in the molybdena. That which I made in order to verify the proportion of the oxygene to the metal in the formation of the acid, consisted in taking a hundred grains of natural sulphurated molybdena, which I put into a mixture of an ounce of muriatic acid and three

three ounces of nitric acid; and in order to avoid all loss by the bubbling up of the mixture, I performed the oxygenation in a long vessel, which I placed first upon a sand bath, and then in a crucible, the sides and bottoms of which were lined with chalk. By this process, I obtained ninety grains of molybdic acid, which indicates fifty parts of oxygen to 100 of metal: the molybdic acid therefore contained in a hundred parts 66,67 of metal, and 33,33 of oxygen.

The regulus of molybdena, which I had obtained in my preceding experiments, furnished me with a new means of verifying these results.

Experiment 20. A hundred grains of the metallic molybdena of the 13th Experiment, were reduced to a very fine powder, and put into a capsule of porcelain; upon these we poured thirteen drachms of pure nitric acid (1,22). An extraordinary effervescence took place, and much nitrous gas was evolved. I evaporated; and during this operation, the matter which was at first of a brownish yellow colour, passed gradually into a whitish yellow; as it dried, it became orange coloured, and even blue, in the places where the heat was the most intense. After having been well dried and collected, it was fused in a glass; its weight was found to have augmented thirty-four grains, which indicates 25,37 of oxygen in a hundred grains of molybdic acid; it was very crystalline, and formed crystals of a silvery white, inclining to a grey.

The change of colour, which has just been mentioned, and which had not till then been remarked, indicated a variation in the proportion of the oxygen to the metal. It appeared probable to me, that a portion, though a small one, of the charcoal which had been mixed with the molybdena, in order to aid its reduction, had combined

bined with it, had produced the phenomena, which had been remarked during the oxygenation, and had changed the proportion of the oxygen to the metal.

Experiment 21. In order to verify this supposition, I thought it necessary to repeat this experiment, employing molybdena which I had reduced by merely placing the mass to be reduced in pulverized charcoal, without having triturated and mixed it with this substance. The experiment failed twice; the first time, on account of the effervescence, and the extraordinary tumefaction which took place when the nitric acid was poured in, and which caused the matter to run over; in the second, the acid had been weakened, but some ejections of molybdic acid took place, which occasioned a loss.

In order to prevent these accidents, the experiment was performed again, in wide capsules. I took a hundred grains of pulverized metal, and poured upon them an ounce of nitric acid, mixed with half an ounce of water. After a few minutes, a very strong action was produced, and the liquor assumed a yellowish red colour, inclining to a brown. As the whole of the metal was not dissolved when the disengagement of gas ceased, I added half an ounce of acid, and placed the solution upon a sand bath; the whole was then dissolved, but the liquor remained of a yellowish red colour, inclining to a brown as before; only a reddish white powder was seen swimming in the liquor. I evaporated to dryness, continually stirring the liquid; the residuum had a copper red colour, intermixed with much white; by continuing to heat, the surface acquired a greyish blue colour; at the sides it was of a brown red, and in some places of an orange-yellow.

Thus it was evident, that the diversity of colour, which the oxygenated molybdena presented, was not occasioned by the charcoal that was mixed with it, but that it might

 arise

arise from the different degrees of oxydation of the metal. It is surprising that molybdena oxygenates itself so imperfectly in this manner, whilst the oxygenation takes place much more expeditiously, and more perfectly, when we employ the sulphuret of molybdena. In order to produce a complete oxygenation, I poured half an ounce of nitric acid upon the dry mass, and heated it. Seeing that no sensible change took place, I added two drachms of pure muriatic acid; the change then became more rapid, the mass became more and more compact, and light coloured, and at last white. It was dried and collected with care, it was heated to redness for a quarter of an hour in a capsule of glass, and after it had been suffered to cool, it was weighed, when its weight was found to amount to 145 grains, to which 3 grains must be added, for what remained adhering to the sides of the capsule; so that in this operation a hundred grains of molybdena had absorbed forty-six grains of oxygen; and accordingly in 100 grains of acid, we have 32,43 of oxygen.

This experiment gives a result which differs little from those obtained in Experiments 14 and 18. I repeated the first once more. I took a piece of fused molybdic acid which weighed a hundred grains; I put it into a crucible in the middle of pulverized charcoal, and I exposed it, for the space of an hour, to the most violent forging heat; the grey mass which I obtained weighed exactly thirty-two grains less than the acid employed.

Thus we may admit, without deviating much from the truth, that a hundred parts of metallic molybdena absorb forty-nine or fifty parts of oxygen when this metal passes into the state of acid; and that, consequently, a hundred parts of molybdic acid contain from thirty-two, to thirty-three of oxygen.

These

These experiments on molybdena in the metallic state, and upon the molybdic acid, confirm the proportions which we have assigned between the constituent parts of the natural sulphuret of molybdena.

VI. *Phenomena which Molybdena presents when exposed to the Action of Fire, in contact with the atmospheric Air.*

A piece of molybdena in the metallic state, weighing 53 grains, of a middling consistence and an ash-grey colour, was put into a Hessian crucible, and exposed to a heat that was gradually augmented. Scarcely had the heat risen to a dark red, when the surface of the metal assumed a brownish yellow colour, and quickly passed into a beautiful violet, inclining to an indigo. The metal was taken from the fire, and, on breaking it, it was found to contain a nucleus, the colour of which was still grey, and had undergone no alteration. From this nucleus to the surface the colour successively passed into yellow, the brownish yellow, and lastly the blue. The metal having been exposed again for a sufficient length of time to the same degree of fire, it became entirely blue. It was necessary to take many precautions in order to arrive at this result, as the surface passed very readily into a higher degree of oxydation, and was quickly heated to redness. Cold water was poured upon this blue mass, which was in part dissolved. The solution was completed by ebullition, and was likewise of a blue colour. When the crucible by heating more powerfully acquired an obscure redness, the metal speedily began to burn, assuming likewise a dark red aspect. At this degree of heat it preserved its colour of a dark blue. When the heat was augmented the metal became almost incandecent; and, after cooling, its surface to the depth of some lines was of a bluish white; more towards the centre it was

blue inclining to a violet, and the nucleus was a violet inclining to brown, like the matter which has been obtained in decomposing the molybdate of ammoniac by the action of heat. The metallic mass, which had but little consistence till the action of the fire had given a white colour to its surface, became more compact and more tenacious: it could now not be crushed without difficulty under the fingers. On augmenting the fire the whole surface became covered with the molybdic acid that was formed. This acid became more and more abundant, and at last was fused.

These phenomena manifestly indicate different degrees of oxydation. The brownish oxyd may be admitted as the first degree. The violet brown oxyd is very probably in the same degree of oxygenation as that which is obtained by heating the molybdate of ammoniac to redness. The blue oxyd soluble in water seems to contain a larger quantity of oxygen. The bluish white oxyd may be considered as a mixture of blue oxyd and white oxyd; and the latter is probably only the molybdic acid which is fused and sublimed by a more intense degree of heat. These different oxyds would therefore succeed each other in the following order: the light brown, the violet-brown or the violet, the blue, and the white.

Among these oxyds the blue principally attracted my attention, on account of the different manners in which it may be produced by oxydation and disoxydation, in the treatment of the molybdena by the acids, the alkaline sulphurets, the metallic solutions, &c.

TO BE CONCLUDED IN OUR NEXT.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

MR. John Austin, of Glasgow, has presented to the Society of Arts, &c. a working model of a weaving loom, which may be driven by steam or water. It is stated to possess the following advantages.

1. From 300 to 400 looms may be worked by one water-wheel, or steam-engine, all of which will weave cloth, superior to what is done in the common way.—2. They will go at the rate of sixty shoots in a minute, or two yards of a nine-hundred web in an hour.—3. They will keep regular time in working, stop, and begin again, as quick as a stop-watch.—4. They will keep constantly going, except at the time of shifting two shuttles, when the weft on the pirns is done.—5. In general, no knots need to be tied, and never more than one, in place of two, which are requisite, in the common way, when a thread breaks.—6. In case the shuttle stops in the shed, the lay will not come forward, and the loom will instantly stop working.—7. They will weave, proportionally slower, or quicker, according to the breadth and quality of the web, which may be the broadest now made.—8. They may be mounted with a harness, or spot heddles, to weave any pattern, twilled, striped, &c. —9. There is but one close shed, the same in both breadths, and the strain of the working has no effect on the yarn behind the rods.—10. The bore and temples always keep the same proper distance.—11. There is no time lost in looming, or cutting-out the cloth; but it is done while the loom is working, after the first time.—12. The weft is well stretched, and exactly even to the fabric required.—13. Every piece of cloth is measured to a straw's breadth, and marked where to be cut, at any given

given length.—14. The loom will work backwards, in case of any accident, or of one or more shoots missing.—15. Every thread is as regular on the yarn beam as in the cloth, having no more than two threads in the runner.—16. If a thread should appear too coarse or fine in the web, it can be changed, or any stripe altered at pleasure.—17. They will weave the finest yarn, more tenderly, and regularly, than any weaver can do with his hands and feet.—18. When a thread either of warp or weft breaks in it, the loom will instantly stop, without stopping any other loom, and will give warning by the ringing of a bell.—19. A loom of this kind occupies only the same space as a common loom; the expense of it will be about half more; but this additional expense is more than compensated by the various additional machinery, employed for preparing the yarn for the common loom, and which this loom renders entirely unnecessary.—20. The reeling, winding, warping, beaming, looming, combing, dressing, fanning, greasing, drawing bores, shifting heddles, rods and temples, which is nearly one-half of theweaver's work, together with the general waste accompanying them, which is about six per cent. of the value of the yarn, and all which occur in the operations of the common loom, do not happen with this loom, which, by its single motion, without further trouble, performs every operation after the spinning, till the making of the cloth be accomplished; by which, independent of the saving of the waste, the expense incurred for reeling, warping, winding, &c. is saved, amounting to above twenty per cent. of the yarn.—21. The heddles, reed, and brushes, will wear longer than usual, from the regularity of their motion.—22. More than one-half of workmanship will be saved: one weaver and a boy being quite sufficient to manage five looms of coarse-work, and three or in fine-work.

List

List of Patents for Inventions, &c.

(Continued from Page 320.)

JOHN FALCONER ATLEE, of Wandsworth, in the county of Surrey, Distiller; for an improved apparatus to be used in fermenting of liquors. Dated March 7, 1807.

JOHN MABERLEY, of Bedford-row, in the county of Middlesex, Gent.; for a method of making and constructing tents, poles, and other machinery, so as to expel and carry off noxious and contaminated air by a readier and more effectual ventilation than can be accomplished by the tents in common use. Dated March 7, 1807.

ELIZABETH BELL, of Blackheath, in the county of Kent, Spinster; for certain improvements in an artificial method of sweeping chimnies, and an improvement in the preparing and manufacturing pieces used for constructing the chimnies invented by her, so as to render the said pieces capable of being better joined together, and more advantageously used for conveying smoke, water, and other fluids or bodies, in a divided and pulverulent state, in any required direction; and also certain methods, machinery, and apparatus, useful or necessary for manufacturing such pieces, and applicable for the purpose of forming various other articles of pottery. Dated March 7, 1807.

JOHN HOULDITCH, of Long Acre, in the county of Middlesex, Coach-maker; for certain improvements in the construction of four-wheeled carriages of different descriptions. Dated March 7, 1807.

HENRY CHARLES CHRISTIAN NEWMAN, Clerk, Rector of St. John's, Capisterre, in the island of St. Christopher; for

for a machine applicable to mills in general, and to various other purposes, but more particularly adapted to the cattle mills employed for expressing the juice of the sugar-cane, by greatly augmenting their power and execution, with fewer cattle, and by increasing the number of the revolutions of the spindle and rollers in the proportion of ten to one of the present mills, or even more if required, by means of a ring, made either of hard wood or cast iron, round the mill, and by an entirely new construction of the axis in peritrochio, the lever, and a lantern wheel or pinion, the trundles or teeth of which turn a cog wheel on the spindle of the mill; which axis in peritrochio, lever, and lantern wheel or pinion, are also constructed as to revolve together with two distinct motions; that is to say, a rotatory one round their own axis, and a progressive circumvolutionary one on the ring; constantly acting upon and compelling the cog wheel and spindle with their separate and united forces. Dated March 7, 1807.

JOHN DAY, of Camberwell-green, in the parish of St. Mary, Lambeth, Stone-mason; for a method of applying friction boxes, either with or without a perpetual screw, spindle, and cog-wheel, to extend and facilitate the power of engines, cranes, capstans, and other machines used for loading and unloading ships or vessels, and for raising anchors and other great weights or bodies, and also to the steerage-wheels of ships or vessels. Dated March 20, 1807.

THOMAS JOHNSON, Mechanic, in Glasgow; for a machine for weaving yarn. Dated March 23, 1807.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. LX. SECOND SERIES. May 1807.

Specification of the Patent granted to RALPH WALKER, *of Blackwall, in the County of Middlesex, Engineer; for a Mode of making Ropes and Cordage.*

Dated August 9, 1806.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Ralph Walker do hereby declare that my said invention of a new mode of making ropes and cordage, which is applicable to the making of ropes and cordage of every dimension or size, from a small line to the largest cable, is performed by the machinery which I have invented for the purpose, and which is described by the plans or drawings hereunto annexed. Those plans or drawings, and the explanation, description, and particulars hereinafter set forth, do particularly describe and ascertain the nature of my said invention, and in what manner the same is to be performed,

Figs. 1, 2, 3, (Plate XVIII.) are plans shewing the construction of the machinery for making rope from the yarns by one and the same machine, at one time and by one operation.

In Fig. 1, A is the main shaft; B B flyers, upon which the bobbins T T T T, round which the yarns are wound, are placed upon moveable axes; as many bobbins, wound round with yarn, are used in each flyer as the number of the yarns that are wanted in each strand. Those flyers move upon their pivots on the arms E E; and there must be as many such flyers as there are strands to make the rope. C C are sections of a fixed wheel, with teeth on its inside. D D are wheels fixed upon the axis of the flyers. F is a wheel fixed upon the main shaft. W shews the centre (or king's) yarn. Now if the main shaft be put in motion by the shaft and wheel G and H, or otherwise, it will turn round the flyers; the teeth of the wheels D D acting in the teeth of the wheel C C, will give the flyers a contrary motion to the main shaft, and twist the yarns into strands at E E. The motion of the main shaft will then lay the strands into a rope. The flyers may receive their aforesaid motion either by the means aforesaid, or from machinery similar to that described at Fig. 8, (Plate XIX.) or by such other ways as the mechanist may think fit.

The motion of the main shaft, with its pinion I, will give motion to the wheel K, and turn round the small wheel L. On the axis of the wheel L is fixed a grooved roller, which presses upon the rope between the two wheels M M, over which wheels the rope lays, and which roller, by that pressure, acts so as to draw out the rope, strands, and yarns from the bobbins. N N are pulleys to guide the strands to the end of the shaft A, where they meet, and are formed into the rope.

The

The small wheels Q and X may be made to move farther up or down upon their axes, to act in wheels larger or smaller, which may be put on in lieu of L and R, so as to draw out the rope with less or greater velocity, as may be requisite. Or, instead of drawing out the rope in manner aforesaid, the rope may be drawn out from the machinery by the wheel-work and shafts P P P, Q, and R.

The wheel R, which is fixed upon an axis, having an universal joint, may be moved farther up or down so as to place the teeth of the wheel Q into one of the larger or smaller circles of teeth upon the convex wheel R. These circles of teeth appear more plain upon the face of the wheel. (See S.)

Fig. 2 is a section of Fig. 1. A is the centre or shaft. B B B are the flyers and bobbins with the yarns. C is the large wheel, with the teeth in the inside, and is fixed in its place. D D D are the wheels fast upon the axis of the flyer, which act in the wheel C. E E the arms and rim for carrying round the flyers.

Fig. 3 is a top view of Fig. 1. The small wheels *a a a a a a* act upon the pulleys N N (see Fig. 1), which bring all the strands equally to be laid into the rope.

Figs. 4, 5, and 6 are plans shewing the machinery for making the rope by different machines and operations.

Fig. 4 shews the machinery for laying the strands of large ropes or cables, and may be put in motion in the same manner as Fig. 1. The strand is drawn out also in the same manner as Fig. 1, and wound upon a reel preparatory to its being laid into rope, which will be shewn by Fig. 6. Or the strand may be drawn from the machinery, and wound on the reel by the two dead pulleys and strap or rope A A. C is the centre (or king's) yarn.

Fff 2 Fig.

Fig. 5 is the section of Fig. 4. Fig. 6 shews the machinery for laying of large ropes from the strands. A is the main shaft, moveable on its pivots at II. B B are the flyers for carrying round the reels with the strands. There must, as in Fig. 1, be one flyer for each strand used in the rope. C C C C are arms fast upon the axis A, in which the flyers move upon their pivots. D a wheel fast upon its shaft, having two circles of teeth. (See K). E a wheel fast upon the axis A. F a wheel fixed upon the lower side of the wheel G, which is moveable upon the axis A. H H are the wheels fast upon the axis of the flyers B B. If the shaft or wheel D be put in motion, it will turn round the wheel E, which is fast upon the shaft A, and carry round the arms with the flyers B B the same time that the outer or larger circle of teeth on the wheel D will act in the wheel F, and will turn round F and G, which are moveable upon the shaft A, with an increased velocity. The wheel G acting upon the wheels H H will also give them motion, in a contrary direction to the shaft A, with an increased velocity (their diameter being less than those of the wheels G G), sufficient to keep the twist in the strand, which otherwise would be taken out by the laying of the rope; and also to give a small increased twist to the strand, in order to bring the centre yarns to an equal bearing with the yarns on the outside of the strand. L L L L are rollers to keep the strands steady in passing from the reels M M to C C. N N N N are straps acting upon the dead pulleys, which are at the ends of the reels, to give the strand a requisite tension in passing from the reels to form the rope. These straps are slackened or tightened, as may be requisite, by means of screws *a a a a*.

The rope is drawn from the machinery in the same manner as is described in Figs. 1 and 4.

Fig.

Fig. 7 (Plate XIX.) shews the machinery for laying small ropes, and is similar in every respect to Fig. 1, excepting that the flyers receive therein a contrary motion to the main axis by means of dead pulleys, with straps or ropes, and may be turned by hand by the crank B.

Fig. 8 is a section of Fig. 7.

For tarring the yarns previous to their being wound upon the bobbins to be used in manner aforesaid, I have used steam, and done it by the following machinery, which I have found useful, and therefore describe it; but I do not claim or consider this as a part of my invention secured to me by the above letters patent.

Figs. 9, 10, 11, and 12, shew the method of tarring the yarns by means of steam, which is conveyed into the case of the tar-boiler A, (see C C, Figs. 9 and 10, which are sections of the boiler and roller for keeping down the yarns in passing through the boiler). The rollers B B may be constructed so as to be raised or lowered according to the quantity of tar in the boiler. The yarns on the bobbins DD are drawn from the boiler as represented in Figs. 10, 11, and 12, by means of pulleys fixed upon the shaft, and in the frame, for holding the bobbins. The bobbins D D are equally filled by means of a frame or catch F F, which rises or falls by means of a heart-wheel or counteracting screws, or by any of the other means in use for producing an alternate counteracting motion.

The proportion of the different apparatus may be ascertained by the scale upon the plan; but the different parts of the wheel-work may be increased or diminished, as may be thought necessary, for laying hard or soft rope.

That the machinery may appear most distinct, and as plain as may be, the framing for supporting the different parts of the apparatus is not laid in the plans.

By

By my said invention of a new mode of making ropes and cordage, the yarns are all laid so as to be made to bear an equal proportion of the strain in the strand and rope; and the strands are laid uniformly in the rope, and each strand and rope receives throughout an equal degree of twist, by which the rope is rendered stronger than otherwise it would be, and of an uniform degree of strength throughout; and the same is either wholly done by one machine and operation, or separately by different machines and operations, in manner above described. These beneficial effects, however, have been produced by others, and publicly used, for some of which, patents have been obtained; but this has only been done by modes or machinery different from my said invention.

My said invention, therefore, is the discovery as well of the above mode of laying the rope immediately from the yarn by one and the same machine and operation, as of the above mode (which is different from, and one that I conceive is simpler and better than, any other yet discovered) of laying the strands, as described in Figs. 4 and 5, so as that the yarns shall all bear an equal proportion of the strain in the strand, and by which, as above described in Fig. 6, I twist the strands uniformly together.

In witness whereof, &c.

Specification

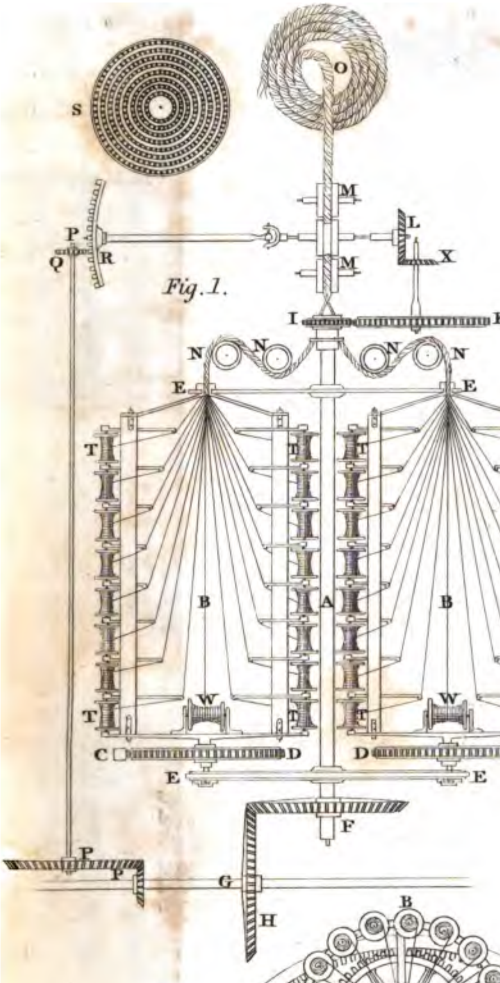


Fig. 1.

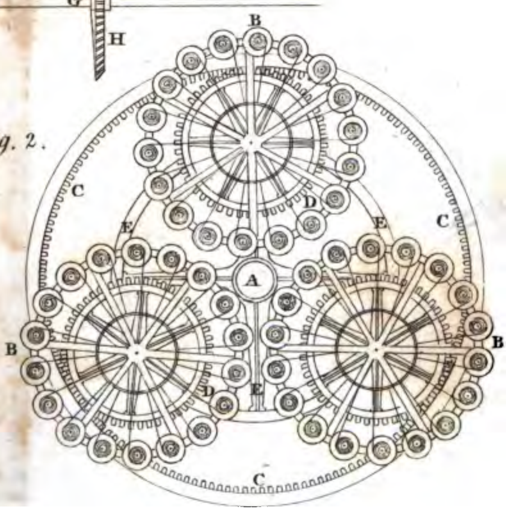


Fig. 2.

Fig. 9.

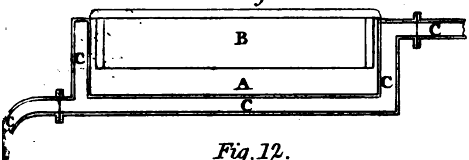


Fig. 11.

Fig. 12.

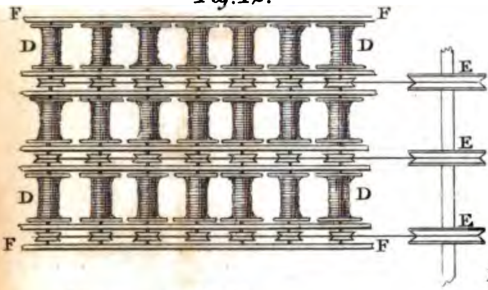


Fig. 10.

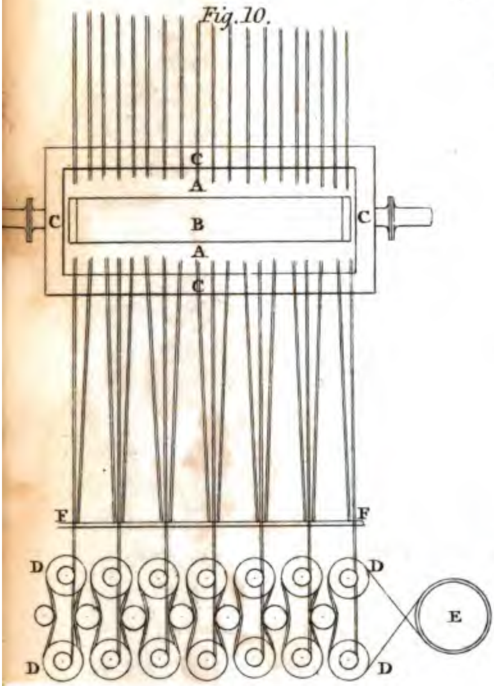
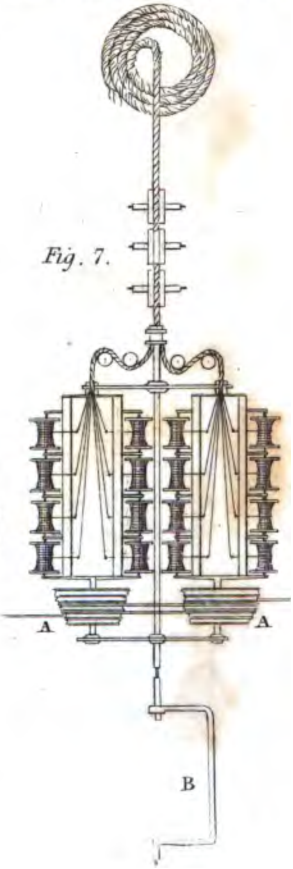


Fig. 7.



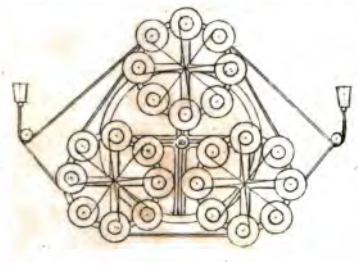


Fig. 8.

Specification of the Patent granted to JOHN CAREY, *Doctor of Laws, of Camden-street, in the parish of St. Mary, Islington, in the County of Middlesex; for an Invention of various Contrivances for preventing or checking Fires, and preserving Persons and Property therefrom, by means of divers Improvements in Alarms, Chimnies, Cisterns, Fire-Screens, and other Articles.*

Dated August 30, 1807.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Carey do hereby declare that my said invention and improvements are particularly described and ascertained in and by the following description.

I. A shower-bath for apartments, warehouses, &c.— Let a cistern be placed in the upper part of a building, to receive the rain-water, or be filled by a pump from below, or otherwise. From this cistern let a pipe of metal, or other fit substance, be conducted into any room, and terminate in a cock near the cieling, or wherever most convenient. Let the plug of this cock be furnished with a cross-bar projecting on each side nine or ten inches, or more. Let one end of the bar be furnished with a weight sufficient to turn the plug, and keep the cock open, when no force at the other end of the bar prevents the fall of the weight; the cock, for that purpose, being placed sidewise, as the ball-cock of a common cistern; and the weight acting as the ball in its descent. To the other end of the bar let a cord be attached, which being drawn tight, and made fast below, shall keep the weight raised, and the cock shut. Let this cord reach the floor, and there be fastened to a ring or other fastening, or run through several rings, &c. so as

as to pass over different parts of the floor, and be fastened only to the last ring; that, if the fire burn any part of it, the weight may immediately fall, and set the cock running.—Instead of rings fastened to the floor, common ring-weights (such as butchers' weights) may be used, which may be moved out of the way in the day-time, and placed at night in the most advantageous situations. —To prevent inconvenience from the cord in the day-time, it may be in two lengths, the one reaching from the bar above to within six or seven feet from the floor, and terminating in a loop, ring, or hook, to which the other length may be fastened at night, and conducted along the floor, as above described. To keep the cock shut when the night-cord is taken away, let a second cord or chain depend from the light end of the bar to within six or seven feet from the floor, and terminate in a loop, ring, or hook, to fasten it to the wall, or elsewhere, as most convenient. This second or day-cord is to be secured to its fastening before the night-cord is removed, and is to be loosed after the night-cord is placed and secured.—From one pipe, several branches and cocks may be conducted to different parts of the room, so that, wherever the fire breaks out, it may burn a cord, and set a cock running. To scatter the water, each cock may terminate in a large rose, like that of a watering-pot. Instead of several roses, one large shallow pan, of metal or other fit substance, may be used, nearly equal in size to the entire cieling, with a slight descent toward the centre, and full of holes; which pan shall receive the water from all the cocks.—The weight fastened to the bar of the cock may be connected with an alarm by a chain or cord, and one or more cranks and wires, so that the fall of the weight shall set off the alarm, and give notice of the fire.—To prevent the entire contents of the cistern

cistern from being unnecessarily discharged, it may be divided into as many compartments as there are cocks; each cock emptying only one compartment; for which purpose, there must be a separate pipe from each compartment to one cock. And there must be a hole or notch in the upper edge of each partition in the cistern, that, in filling it, the water may overflow from one compartment into another.—Instead of a rose, the cock may be furnished with a hose or tube of leather, or other fit substance, with a pipe or nozzle at the end, so that a person may direct the stream of water where he pleases: and, in this case, the cock, hose, and nozzle, may be concealed in a closet.

II. A chimney shower-bath.—A cistern being placed in the upper part of the house, let a cock communicate from it to the chimney: the cock to have a cross-bar and weight, as in the preceding case, except that here the operation of the weight is reversed; and the weight, when left at liberty, keeps the cock shut, and must be pulled up, to set it running. From the light end of the cross-bar, let a wire or string be conducted down to the apartment where the chimney opens.—When the chimney is on fire, let the wire be pulled, and either held in the hand, or hitched on a hook or other fastening, and so kept fast until a sufficient quantity of water has poured down the chimney. Then, the wire being let go, the weight will fall, and stop the cock.—The communication from the cock to the chimney is as follows: To the outer extremity of the cock, let there be fastened a hose or tube of leather, or other fit and flexible substance, one or two feet in length, or more, if required. Let the outer end of the hose be fastened to a pipe of metal or other fit substance, of sufficient length to reach from the outside of the brick-work to the centre of the chimney-

funnel, or thereabouts, and of bore sufficient to give passage to as large a stream of water as the cock can discharge. Let that end of this pipe which stands in the centre of the funnel, terminate in a hollow globe of larger diameter; or a half globe, of which the flat side is to be placed horizontal; the globe or half globe to be full of small holes, to scatter the water in every direction.—This pipe is not to be immovably fixed in the brick-work, but removeable at pleasure, for the purpose of cleaning, or making way for a chimney-sweeper, or sweeping-machine. It may either be let through a hole in the brick-work, which may be stopped round it with clay, loam, or any other fit substance; or a second pipe, of metal, stone, or other fit substance, and sufficiently wide to admit the former tube, may be immoveably fixed in the brick-work; and the former tube being thrust through it into the chimney, the vacancy may be filled up with clay, &c. as above.—The cistern may have as many cocks as there are chimney-funnels; one cock, with its apparatus, for each funnel. The same cistern, which supplies the shower-bath for apartments, may also serve for the chimnies.—To save the trouble of frequently taking out the pipe to clean it from soot, the holes in the globe or half-globe may be stopped with whiting, or any other substance which will quickly dissolve, and leave a passage for the water; and the globe or half globe may have an opening at the top, to admit the finger or any instrument used in plastering the holes inside; and this opening may be closed with a cork, metal, or other stopper.

III. A chimney-stopper, consisting of a frame of wood or metal, or both, covered with a metallic plate or plates, and of sufficient dimensions to close the opening of the chimney or fire-place, to which it is to be applied when the

the chimney is on fire.—This stopper may be in a single piece, or made to fold into two or more leaves, like a fire screen. It may also be made with a part of each leaf to slide up and down, after the manner of fire-screens; and may be painted, japanned, or otherwise ornamented, to serve the purposes of a fire-screen or a chimney-board.

IV. A damper gridiron, with round, semicircular, triangular, square, or rhombic bars, placed in contact with each other, or very nearly so; the semicircular bars having the flat side down; the triangular resting on the base of the triangle, with the vertex upwards; the rhombic having the acute angles above and below; and the square being placed either side to side, or angle to angle. The bars may either be loose, or riveted, screwed, or welded, to a frame. The frame may either be a simple iron bar formed into a square; or it may have a raised edge or margin like that of a frying-pan. In the latter case, suppose a square or oblate frying-pan with either a sloping or perpendicular margin, having the handle and front margin cut away, and also the entire bottom, except about a quarter of an inch on each side, and (for the fixed bars) about half an inch at the back, and the same in front, or (for the loose bars) about half an inch at the back only. Then, to have fixed bars, let them be riveted, or screwed, or welded, on the half-inch bottom in front and rear; and let a handle, with a cross-piece, in the shape of a T, be fitted into the front, with the two ends of the cross-piece turned up, to be riveted, or screwed, or welded, to the outer ends of the side margins; or the front rivets or screws may pass through both the cross-piece and the bottom.—For the loose bars, let a cross-bar be fixed underneath the supposed cut frying-pan, at or near the front; and let a T handle be

fastened (as above described) to the outer ends of the side margins. Then let the parallel bars be turned up about half an inch at the inner end, so that, when the outer ends are thrust between the front cross-bar and the T handle, the turned up ends shall lie against the rear margin, while the straight ends rest, in front, on the cross-bar underneath. To secure the bars in this position, let a hole be made in each side margin, about a quarter of an inch from the rear margin (more or less, according to the thickness of the bars) to receive another cross-bar, which shall confine the parallel bars in their station. This cross-bar may have at one end a head or shoulder, and, at the other, a screw to receive a nut, or an eye to receive a key or bolt, to prevent it from dropping out. Or the cross-bar, without passing through the side margins, may be turned up at both ends, and each end fastened to the side margin with a screw, pin, or turn-buckle, leaving it removeable at pleasure. Or, instead of turning up the inner ends of the bars, they may be left straight, and a notch be made in each, to receive the cross-bar which is to confine them.—In any case, the gridiron may have feet riveted, or screwed, or welded underneath or to the outside of the margin; and be furnished with a pan in front, to receive the fat, in the same form as the pan attached to hollow or concave barred gridirons, or any other shape that may be convenient; and, for this purpose, it is proper that the gridiron stand sloping, with a descent forward.

V. A lock-lantern for stables, nurseries, &c.—The lantern may be of any shape or size, made of or covered with close woven wire. And, that children or servants may not so readily open this, without discovery, as a common lantern, it may be fastened with an ordinary padlock, or with one of the following kind. Suppose

one

one of the common small square spring-padlocks, of which the inner work consists of a spring and the small piece which may be called the bolt. Instead of one key-hole, let two holes be made in front—the one to allow room for the motion of a little knob or button, by which the bolt is to be drawn back, as in the lock of a pocket-book; the other to admit the shank of the key. The key is to be in the shape of a T; the perpendicular piece, or shank, being round, and the transverse piece, or handle, round, square, triangular, or flat, at pleasure. Near the bottom of the shank is to be a circular groove, sufficient to admit the side of the bolt, which may be made thinner in that part for the purpose. Or, without making any difference in the thickness of the bolt, a hole may be made in the back of the lock, corresponding with the key-hole in front, so that the end of the key, below the groove, shall sink into the back-piece. The bolt, when at rest, is to cover about one third of the hole; and the shank of the key to be tapered to a point below the groove, that, when thrust in, it may make its way, and push back the bolt, which will again be driven forward by the spring, and will catch in the groove, as soon as the key has penetrated to its proper place.—Over the front of the lock, let there be a door or shutter, turning on a hinge or pivot, as is common in small square portmanteau locks. It may (like them), or it may not, have a spring underneath, to throw it open. In this door let there be a hole exactly corresponding with the one or two holes for the key, already mentioned, and an enlargement of that hole by a slit on each side, barely sufficient to let the handle of the key pass through.—To apply this lock, two operations are necessary, *viz.* to fasten or lock it to the ring or loop from which it is to hang, and to gag or close it: but it is indifferent which of the two operations

operations is performed first. It is fastened or locked by pushing down the curved arm or bow at the top, as practised in common spring padlocks. It is gagged or closed as follows: Let the shank of the key (first passing through a shield, hereafter to be described) be thrust through the hole in the door and the hole or holes underneath, until the bolt has caught the groove in the shank of the key; the handle of the key being turned in a different direction from the slit in the door. The key and shield are then to remain attached to the lock in that position.—The shield, above-mentioned, is a bit of card, or paper, or parchment, about the size of a six-pence (more or less), so marked as to be easily recognised, and having a hole in the middle, to admit the shank of the key. This shield, being confined by the handle of the key, renders it difficult (if not impossible) to open the lock without tearing the shield, unless the slit in the door be too wide.—To unfasten this lock, tear off the shield; turn the handle of the key exactly over the slit in the door, so that it may pass through, and leave the door at liberty to open, whether it be pushed up by a spring underneath, or pulled open with the finger. The door being opened, draw back the bolt by means of the little button or knob, before described, as in the instance of a pocket-book lock; and you at once liberate the key, and the curved arm or bow at the top.—To cover the shield and the handle of the key, a second door may be added, turning on a hinge or pivot, and to be fastened and unfastened either by means of a concealed spring and catch, as is common in the square portmanteau locks before mentioned, or by means of a spring and button, as in watch-cases, or pocket-book locks. This second or outer door may be fixed either to the outer edge of the inner door, to open in the contrary direction, or toward the opposite

edge,

edge, to open in the same direction with it. Or the outer door may be attached to the lock by a rivet or pivot in one side or corner, and made to move in a line parallel to the face of the clock. Or, instead of this second or outer door, a sliding piece may be used, moving up and down, as the slide used to cover the aperture in some kinds of padlocks and key-hole 'scutcheons; the inner door having three of its sides turned up, and so formed as to present a groove or dove-tail cavity to receive the slide.

VI. A fire-cloak or gown, which may be of any convenient shape or size, to protect the wearer from external fire, or extinguish fire in the wearer's other clothes. It may be made of leather, silk, poplin, callimanco, or other stuff or substance little liable to catch fire; lined with any stuff or substance of like description, and quilted, with a stuffing between, of hair, wool, or other substance not very inflammable. It may have a hood or cowl to cover the head; which hood or cowl may be joined to it, or separate.

VII. A soot-trap for chimnies, thus—Let the chimney be closely fitted, a few inches above the opening of the fire-place, with a horizontal or sloping stone slab or metal plate, or with brick-work or masonry; leaving, in each case, a round, square, or other-shaped hole toward the back of the chimney, for the smoke to ascend: the size of the hole to be proportioned to the quantity of smoke that is to pass, with allowance for the impediments hereafter to be described. To this hole let a metal tube or box be fitted, so that it can easily be put in and taken out. The length of the tube or box may be from five or six inches to twelve or more: its upper end is to be open; the lower, grated with thin bars, from an eighth of an inch asunder to half an inch or more. Or the

the bottom may be a metal plate perforated with numerous holes. In this box, let there be lodged a quantity of coarse gravel, or small pebbles, or stone-cutter's rubbish, or metal chain, or any other un-inflammable thing or things, which will leave a passage for the smoke: the quantity to depend on the draught of the chimney, and to be determined, in each case, by actual experiment.—Let the box, thus prepared as a strainer, be thrust up into the opening above mentioned, until its bottom be level with the inferior surface of the slab or plate, &c.; and let it be supported in that position by one or more hooks, bolts, turn-buckles, or springs, which may be adapted in various ways not needing description. The smoke passing through this strainer, and depositing part of its soot, the strainer must occasionally be taken down, and cleared from the soot; the gravel, &c. being either washed clean for further use, or thrown away, and replaced by new.—In the same strainer, gravel, &c. of two or more sizes may be used at once; the coarser being placed lowermost, with a wire grating or perforated plate laid upon it, to prevent the finer from passing down.

VIII. A soot-trap stove, or stove-top, thus.—Suppose a register stove, of any shape, made smoke-tight in the top and back, excepting a hole for a strainer, as before described: then let a strainer be adapted to it, as above. Or, let the hole be in the back, close to the top, and calculated to admit a strainer in the shape of a drawer: the front of the drawer to be either a perforated plate or a grating, as above described. The drawer may be partly covered in at top, toward the front, so that the smoke shall pass out only toward the rear; or it may be entirely covered in at top, and the back part be (like the front) a grating or perforated plate, so that the smoke

shall

shall only pass out at the back. In the latter case, the back is to be loose, to be put in and taken out at pleasure, and may be fastened with one or more hooks, pins, turn-buckles, or springs; or it may be made to move on a hinge or hinges, to open and shut as a door.—The drawer is to be furnished with gravel, &c. as the upright strainer, and may, like it, contain different sizes of gravel, &c.—Instead of the drawer-shape, the strainer may be made round, square, triangular, or in various other shapes, at pleasure.—A register top (*i. e.* all that part of a register-stove which stands above the level of the hobs) may also be fitted with a strainer, either perpendicular or horizontal, and adapted to a common stove or range, by being fixed on the hobs, and made closely to fit the opening of the chimney.—The soot-trap stove may be made after another fashion, thus—Suppose a stove of that kind (now sufficiently known) in which the smoke, after ascending from the fire, descends between the back plate and another plate behind it, and, passing under the latter, rises behind it into the chimney. Let an opening be made at the bottom of the outside or visible back plate, to receive a drawer, which is to be put in and drawn out through the ash-hole, on the level of the hearth. The sides of this drawer are to touch the bottom of the second or invisible back plate, beyond which its back part is to stand two, three, or more inches further into the chimney. The drawer is to be furnished with gravel, &c. as above, to serve as a strainer. And, that the smoke may at once take its direction to the strainer, let either the visible back plate or the invisible one behind it, or both, be furnished with ledges, to narrow the passage between the two plates into a funnel sloping from the ends of the opening above (where the smoke first begins to descend) down to the upper corners of the

opening which admits the drawer. This funnel is to be made smoke-tight. The drawer being lodged in its place, its outside edges may be plastered with loam, or any other fit substance, to prevent the escape of smoke in front below.

IX. A chimney water-trough, thus.—A few inches above the opening of the fire-place, let a metal plate, or stone slab (either horizontal, or sloping upward towards the back) closely stop the chimney in front and on each side, leaving an opening of two, three, or more inches at the back. From the back edge of the plate or slab, let a ledge (either perpendicular, or sloping downward towards the back of the chimney) descend a few inches, but not so low as the opening of the fire-place. Under this ledge, let a metal trough be placed, of such dimensions as to fit the breadth of the chimney, and to present an opening of two or more inches in front and rear of the descending ledge. The depth may be varied at pleasure; and it may either be placed above the level of the coals in the fire-place (resting on the back-plate or upon brickwork), or (with increased depth) made to form a back to the fire-place. Let the lower edge of the ledge be exactly horizontal, to form a parallel line with the water in the trough; and let it descend so low, that if the trough were filled or nearly filled with water, the liquid would entirely stop the passage.—The trough may be supplied with water from a reservoir in an adjoining closet or other convenient place, through a pipe terminating in a ball-cock within the trough, so that, as the water in the trough is diminished by evaporation, the cock may of itself supply the loss: the cock to be so adjusted as to keep the water at that precise height which will only just permit the draught of the chimney to carry off the smoke; which height is to be ascertained by actual experiment

experiment in each particular case. Instead of the common spherical buoy or ball to the cock, a cylindrical or oblong-square buoy may be used, particularly where the trough is narrow.—To empty the trough of the water, with whatever sediment of soot, &c. is collected in it, let its bottom be slightly sloped from one side of the chimney to the other; and, from the lower side, let a pipe and cock be conducted into an adjoining closet, or other convenient place for drawing off its contents.

X. A chimney-damper, consisting of a double piece of hair or woollen cloth, of such dimensions as to cover and close the opening of the chimney. It is to be quilted and stuffed between with hair, wool, or sponge. When the chimney is on fire, this damper is to be well wetted with water, or any other un-inflammable liquid, hung against the chimney-opening, to stop or diminish the draught of air, and kept wet until the fire is extinguished.

XI. A water candlestick and candle, thus.—Let a pan or basin, of glass, metal, earthen-ware, or any other substance fit to hold water—either round, square, or of any other shape at pleasure—and six or more inches deep—be furnished with a socket (either fixed or moveable) whose top shall stand at least half an inch lower than the margin of the pan, and the diameter of its bore be proportioned to the size of the candle intended to be used. The socket to have one or more holes near the bottom, to let water pass freely.—The moveable socket may be of a different substance from the pan, and must have a broad heavy bottom, to support it upright.—Let water be poured into the pan, until it rise about an eighth or quarter of an inch above the top of the socket. The candle may be placed in the socket either before or after the water is poured in. It may be slightly tapered, like

on mould candles, or perfectly cylindrical, but, in r case, much thicker in proportion to the wick, h may be of thread, cotton, or rush, waxed or un-ed. Its length is to be proportioned to the time it is nded to continue burning.

n witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

Nos. I. and II. A single cistern will answer both pur-oses, will serve for all the apartments and chimnies in house, and may be made to serve a whole range of uildings, by running the pipes from one to another.— t will be proper occasionally to turn the cocks, for the urpose of keeping them in order, and of drawing off he stagnant water and sediment from the cistern; which nay be effected by means of a leathern hose fastened to he nozzle of the cock, and conducted to a window or other convenient place for discharging the water.

No. III. The *Chimney-Stopper*, if tastily executed, will make a very elegant and ornamental fire-screen, cal-culated to grace the most fashionable drawing-room; uniting also safety with beauty, as it is proof against flying sparks, and may therefore be advantageously used as a fire-guard in the absence of the family. Indeed it is much more likely to be employed for these latter pur-poses than for that of stopping a chimney on fire.

No. IV. On this *Gridiron* it is [illegible] smoke or singe the meat, how[illegible] smoke and blaze: of cours[illegible] to stand watching the [illegible] attend to other busi[illegible]

tually preserves the chimney from the danger of fire, as none of the fat falls on the coals; the whole of it flowing into the pan or receiver.—The cookery on this gridiron is esteemed, by some persons who have tasted of it, to be more delicate than that performed on any other of the gridirons in use.

No. V. The *Paper Padlock* (exclusive of its use in conjunction with the lantern) is applicable to all the purposes of a common padlock, and likewise to other useful purposes of a quite novel nature. By means of a cheap and simple contrivance, it may in a moment be attached, without injury, to the key-hole of a door, desk, chest, &c. so that neither key nor pick-lock can be introduced without certain detection.—By another still more simple contrivance, it may be made to prevent or detect the fraudulent exchange of articles purchased at market, or sent as presents to a distance.

No. VI. The *Fire-Cloak* will effectually secure a lady from the fatal effects of her muslin dress catching fire, as she can, in a moment, wrap herself up in it, and thus extinguish the flame; a circumstance highly worthy of attention, since almost every day's paper announces some shocking catastrophe occasioned by such accident.—In making the cloak, elegance may be so far combined with utility, that it will by no means prove an unsightly object, if kept constantly exposed to view, and ready for immediate use.—In suddenly starting from bed to escape a nocturnal fire, it may be instantaneously put on, and will comfortably screen the wearer from the cold and damp, as well as from the flames.

Nos. VII. and VIII. The *Soot-Trap* and *Soot-Trap-Stove*, if properly managed, will so far diminish the collection of soot in chimnies, that they will very seldom require to be swept. The danger of fire in a chimney will

will be almost done away; and the smoking of chimnies, in many cases, prevented.

No. IX. The *Water-Trough* will produce the same desirable effects, without the trouble of putting in or removing the soot-trap.

No. X. The *Chimney-Damper*, simple as it is, may be of great utility. Being hung up in some conspicuous place, where it shall be daily seen by the servants, with a printed paper of directions for its use, it can be instantly employed the moment a chimney catches fire, and will effectually extinguish it, without further trouble than that of keeping it wet while it hangs against the grate.—In any house where this is adopted, every fire-place ought to be furnished with a pair of hooks or other fastenings (one upon each side), to hang the damper on; which hooks or other fastenings may be made ornamental. The damper also should, for the purpose of suspension, be furnished with rings or loops, in such number, and at such distances asunder, as to suit every fire-place in the house.

No. XI. This new *Water-Candlestick* has the advantage of being less bulky and cumbrous than those in ordinary use, and less liable to be overset, besides affording a good light, and screening the candle from draughts of air. In point of safety, it can hardly be surpassed. The candles also will last much longer, in proportion to their weight, than common candles or rush-lights, and may, without variation in the thickness, be varied in length, so as exactly to suit the hours of the consumer.

Specification

Specification of the Patent granted to WILLIAM HANCE, *of Tooley-street, in the Parish of Saint Olave, Southwark, and County of Surrey; for a Method of rendering Water-proof, Beaver and other Hats.*

Dated January 29, 1807.

TO all to whom these presents shall come, &c. Now KNOW YE, that in compliance with the said proviso, I the said William Hance do hereby declare that my said invention is described in manner following; that is to say: Take a thin shell, made of wool, hair, and fine beaver, to form the crown of the hat; likewise a shell or plate of the same materials to form the brim. When these two parts are made, they must be dyed black, and finished without any glue or stiffening of any sort, care only being taken to bring them to a good jet black. As no glue or stiffening is used, no rain can injure the nap, which in all other beaver hats, after being exposed to a heavy shower of rain, draws out the glue, which sticks down the nap, and makes it appear old and greasy. But these hats, after a heavy shower of rain, require to be only wiped round with a handkerchief, soft brush, or any other proper thing; and when dry brush them over again, and the nap will flow the same as before. There may be a thin shell, made of wool, hair, or fine beaver, as before, in the shape of a hat, blocked deep enough to admit of the brim being cut from the crown. Or a shell, made of the same materials, in the shape of a hat, will answer the same purpose; though I give the preference to the outside shell to be in two parts. The underneath side of the shell and the inside of the crown must then be made water-proof, by first laying on a coat of size, or thin paste, or any other proper substance, that will be sufficiently

sufficiently strong to bear a coat of copal varnish; and when thoroughly dry another coat of boiled linseed oil, very strong. When sufficiently dry and hardened the crown must be put on a block, and a willow or cotton body or shape, wove on purpose, put into the inside of the crown, and cemented in. It must then stand on the block till dry; then finished off with a hot iron, and the crown is done. The brim must in like manner be cemented to a substance or body made with willow, wove on purpose, or cotton, or other fit material, sufficiently thick to make the inside of the brim. The brim or shell of beaver, with the body made of willow, or any other fit material, must then be put in a press, and pressed well together. When pressed sufficiently, it must be hung up to harden; then the underside of the brim may be covered with another shell of beaver, made on purpose, but silk-shag will answer the same purpose, and make the underneath part handsomer; or a willow may be wove to cover the underneath with, or it may be covered with any other fit material. The crown and brim thus made must be put on a small block, to form the brim and crown: it must then be strongly sewed together. The hat is then formed, and put in shape. The edge of the brim must be oiled and varnished with copal varnish and boiled linseed oil, very strong, as before, sufficiently to prevent any rain getting in. The cement used for sticking the parts together may be made with about one pound of gum senegal, one pound of starch, one pound of glue, and one ounce of bees wax, boiled together in about one quart of water; or any other proper cement may be used.

In witness whereof, &c.

Specification

Specification of the Patent granted to GEORGE ECKHARDT, *of Berwick-street, Golden-square, in the County of Middlesex, Gentleman, and Member of the Royal Society of London, and of the Society of Haerlem in Holland, and* JOSEPH LYON, *of Millbank-street, Westminster, Cooper; for an Improvement on, and a new Method of, manufacturing Pipes for the Conveyance of Water under Ground.*

Dated December 18, 1806.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, we the said Anthony George Eckhardt and Joseph Lyon do hereby declare that our said invention, and the manner in which the same is to be carried into effect and practice, are described in manner following; that is to say: instead of perforating the trunk of a tree, or any solid piece of wood, as is usually done in the fabrication of pipes for the conveyance of water, we do form each and every of our pipes of different pieces of staves, resembling the staves of a barrel, but of less curvature, and of greater proportional length. And we do fashion the said staves of our pipes either by hand or (in preference) by such fit and appropriate machinery as among the tools, implements, and machines, of well known construction and use, may be best suited for that purpose, in such a manner as that the said staves shall fit each other, and include a cylindrical, or nearly cylindrical, bore or cavity; and that the external surfaces thereof shall form a conical or long spheroidal or otherwise tapering figure, properly suited for driving a sufficient number of strong hoops, of metal, or other fit material, thereon, for the

purpose of giving firmness and strength to the whole, and of rendering the same water-tight. Or otherwise, we do close the said staves together by driving wedges under the said hoops, or by screwing the said hoops together; and in these or the like cases the external surfaces of the said pipes may be cylindrical, or of any other convenient figure.

And farther, we do taper, by the turning-lathe, or otherwise, such of the extremities of our said pipes as are intended to be fitted, by insertion, into other lengths or pieces of the said pipes. And we do also excavate and enlarge a correspondent small part of the bore of such other lengths or pieces of our said pipes as are, or may be intended, to receive the said tapering extremities.

And, moreover, we do, in all cases wherein the same may be thought needful, connect and close our said staves together by the methods of dove-tailing or tongueing, or rabbetting, or by means of screws, or by any other of the known and approved methods of joining the surfaces of wood together. And we do paint or cover the inner or outer surfaces, or the surfaces within the joints, or all or any of them, with pitch, tar, varnish, cement, or other suitable matter, to preserve the said pipes, and to render them more effectually water-tight.

And, lastly, we do make use of all kinds of wood, or other materials whatsoever, which are or may be proper for the construction of our said pipes, as herein before described and set forth.

In witness whereof, &c.

Improved

Improved Drags for raising the Bodies of Persons who have sunk under Water. By Dr. COGAN, *of Bath.*

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Gold Medal or Thirty Guineas, at the Option of the Candidate, were adjudged by the Society to Dr. COGAN, *who preferred the honorary Reward.*

I HAVE long been discontented with the construction of the drags which have hitherto been in use, both in this and in other countries. Those used in Holland are not more than three or four inches in diameter, with very long and sharp points. They cannot therefore be properly applied to a naked body; and were not the Dutch sailors and boatmen, who are most exposed to danger, very thickly clad, they might be productive of mischief. I attempted, when resident in that country, to make some improvements, by turning the points obliquely inwards, so as to catch the clothes without penetrating deep into the body; but still these were only applicable in cases where the subject fell into the water in his clothes. The drag which is now used in London is, in many respects, exceptionable; it is clumsy and dangerous.

The design of establishing a Humane Society at Bath, induced me to reconsider the subject with more attention; and the result has been the construction of two drags, according to the models which are sent to you, at the desire of that Society. The consideration of economy has induced me to constructthe drag, Fig. 2. (Plate XX.) as it may be made at about half the price of the other, and

in some cases be equally useful. The drag, Fig 1. is applicable to every case, and the only objection to it is its higher price.

You will perceive by the annexed drawing the object in view, which is to multiply the chances of laying secure hold of any part of the body, without the possibility of an injury. Had the dimensions been smaller than they are, the drag would not encompass every part of a human body; and without the partition and curvatures at the extremities, the distances would be too great, and the body of a child might fall through the intermediate spaces. By means of the sliding hooks at the ends, the instrument is adapted both to naked bodies, and those which are clothed. As bathers are naked, the sharp-pointed extremities might lacerate in a disagreeable though not a dangerous manner: or by entering the skin, they might impede a firmer hold. They are therefore made to recede. But in accidents from skaiting, or in such where the subject falls into the water with his clothes on, the hooks will be of the utmost advantage, as the slightest hold will be sufficient to render the body buoyant.

The upper extremities are made both with a socket and a loop, by which they were accommodated either to a pole or a cord; or, which is still better, to both. In ponds or rivers, where accidents are most likely to happen, should they occur at a distance from the shore, no pole would be able to reach to a sufficient extent, unless the assistants were in a boat, which is not at all times at hand. In such cases a cord may be attached to the loop, and the instrument be thrown to the place where the body is supposed to lie. If the person exposed to danger should be able to swim a little, or in any way just support himself from sinking, he might possibly lay hold of the floating piece of wood connected with the lower end of the drag by means

means of a rope, and thus be brought to shore. This appendage answers another purpose. In rivers particularly, the limbs of the instrument may probably catch roots of trees, &c. and can only be disengaged by pulling the drag in a contrary direction by means of the floating wood and rope.

When I said that both pole and cord are preferable to either singly, it was for the following reason. I have found by experiments, that a cord tied to the ring or loop, and passing through a hole made at the upper end of the pole, gives a double advantage. The drag with a pole attached to it, of not more than 10 or 12 feet in length, may be projected several yards further than without it; and in drawing forward the drag, till the end of the pole is brought within reach of the hand, the subject may be raised above the surface of the water in the most proper direction. But a pole of 15 or 16 feet in length is unwieldy, and would even float the drag unless it were made much heavier.

If a drag were wanted in these cases only, where it is not necessary to throw it to a distance, then Fig. 2. would answer every purpose. It is obvious that this requires a pole to be fixed in it, so that the hand may direct the projecting parts to the body, which otherwise could not always be done.

We have not as yet had an opportunity of trying these drags upon a human body; but upon an effigy made in every respect as like as possible in form to the human body, both clothed and unclothed, they have answered in the most satisfactory manner. The effigy was brought to the surface in various directions, without once slipping from the hold.

I shall just beg leave to add, that with two drags and a boat, assistance given in time would almost insure success.

A hook

A hook catching a single thread, it is well known, will be sufficient to bring a human body to the surface of the water, or till it becomes visible: a second drag at such time might be applied to any part of the body, so as to secure a firm hold.

The workman charges the triangular drag at one guinea, the other at 12 shillings. A pole 16 feet in length was charged three shillings. The fags were estimated at one shilling and sixpense.

Reference to the Engraving of Dr. Cogan's *Drag.*

(Plate XX. Figs. 1, 2, 3, and 4.)

Fig. 1. A shews the drag complete, with two cords B and C attached to it; that at the top, B, is fastened to a ring at D; the bottom cord is tied to a hole in the iron at E. The six ends of the projecting branches have each a barbed claw, which can be slided forward or drawn back as may be thought necessary. There is a hollow socket in the upper part of the drag at D, so as to admit the end of a pole to be screwed therein, whenever it may be thought useful.

Fig. 2. is the cheaper or more simple drag, and intended only to be used with a pole G, fastened in its hollow socket by the screw H, and to be used in the manner of a rake to bring the body to land. It has barbed claws at the extremities of its branches L L, moveable backwards and forwards, which claws slide in a groove made in the extremity of each branch.

Fig. 3 shews one of the claws drawn upon a larger scale, screwed to one of the extremities of a branch. In this situation the screw head appears at I, on the outside of the branch, and the claw is within, and does not extend beyond the extremity of the branch.

Fig.

Fig. 4 shews the same barbed claw at its utmost extent, projecting beyond the extremity of the branch. The end of the worm of the screw, which holds it fast in that position, appears at K.

Machine to enable Shoe-makers to make Shoes and Boots without suffering that Pressure upon the Stomach usual in that Trade; invented by Mr. A. Stass, of Porter-street, Newport Market.

With Engravings.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

Ten Guineas were voted to Mr. STASS *for this Invention.*

THIS Machine is to be used by men when making shoes or closing boots, and is constructed to save them the disagreeable and hurtful posture they now use, by sitting in a cramped and painful situation; and it has been vouched for by physicians of the first abilities, that most of that particular class of labouring men die of asthma and consumption, occasioned by constant application in so unwholesome a posture.

This machine, simple in itself, is so constructed, that a man may stand to his work, sit, or recline in a half sitting posture, and without having constantly his work pressing against his breast or stomach. It is not awkward; but from the inspection of some of the first workmen in the trade, has been highly approved of in every respect, being not only useful, but of great comfort and convenience when compared with the method of working heretofore adopted.

Reference

Reference to Mr. Stass's *Machine for Shoe-makers.*

(Plate XX. Figs. 5 and 6.)

Fig. 5, *a* the bench standing on four legs about four feet from the ground.

b a circular cushion affixed to the bench, in the centre of which cushion is a hole quite through the bench, through which a leather strap *c* is brought up from below. This strap holds the work and last firm upon the cushion, in any position required, by means of the workman's foot placed upon the treadle *d*.

e shews the last upon the cushion, with the strap holding it firm.

f is a seat for the workman to use occasionally; it is supported behind by two legs, and in the front by a cross piece of wood, into which a projecting arm extends from the seat, and allows the seat to be moved nearer or farther from the work as may be required.

g, a shelf, on which the hammer may be laid.

h, a leather bag to contain the tools.

i, a drawer, to hold such articles as should be kept free from dust.

k, leather slips to contain the cutting knives.

l, a whetstone, on which the knives are to be sharpened, and moveable on an upright pivot or axis *m*.

n the upper part of the bench to hold the lap-stone, &c.

Fig. 6 the lap-stone. The conical part *o* fits into the hole in the cushion *b*, so as to hold it firm, whilst the leather is beaten with a hammer.

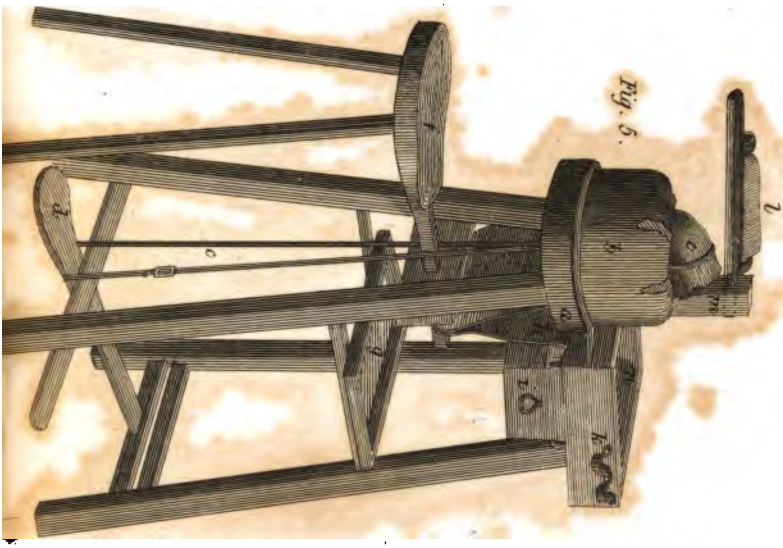


Fig. 5.

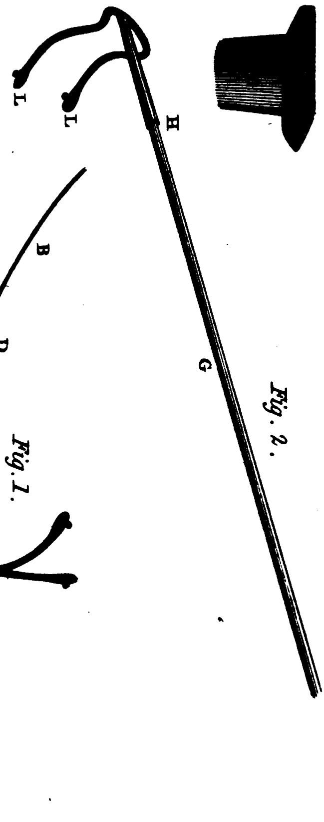


Fig. 6.

Fig. 2.

Fig. 3.

Fig. 4.

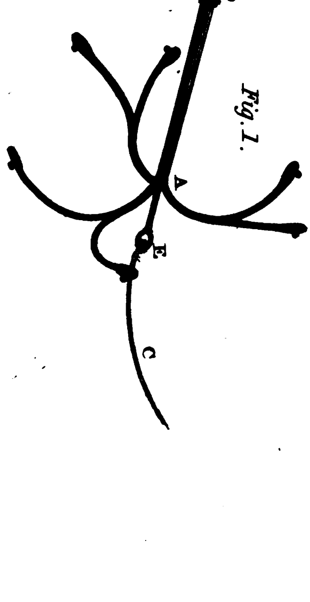


Fig. 1.

Experiments on Molybdena. *By* M. BUCHOLTZ.

(Concluded from Page 396.)

VII. *Experiments on the blue Oxyd of Molybdena.*

EXPERIMENT 23. I put fifty grains of pulverized metallic molybdena into a porcelain crucible, which I placed upon the fire in an inclined position, and heated till the surface had assumed a blue colour. At the first application of the heat, the powder assumed a brownish yellow colour, which soon passed into a copper-brown: the latter colour continued for some minutes, until the crucible had acquired a more elevated degree of heat. The metal burned in a place where the crucible scarcely began to exhibit an obscure redness. I immediately withdrew the crucible, and kept it exposed for a quarter of an hour to a moderate heat, continually stirring the powder. The brown colour passed entirely into a greyish blue. When carefully collected and weighed, the matter was found to have augmented by five grains; that is, by one tenth. I poured upon it an ounce of water, and stirred it for some minutes: only a very small portion of matter was dissolved. The mixture was kept for two hours in a heat of thirty degrees: the solution assumed a deep sapphire-blue colour: its taste was bitter and metallic. I decanted, and poured a fresh quantity of water upon the residuum. Operating in the same manner as before, I obtained a solution of a very pale blue. I boiled the residuum with two ounces of distilled water, in a porcelain cup, till the liquid was diminished by one half. After the pulverulent particles had deposited themselves, I had a solution of a deep and beautiful sapphire blue. The result was the same when I repeated this process a

second time. It is evident that the oxyd formed in this experiment comported itself differently from that obtained in the preceding experiment (22), where the blue oxyd obtained by the calcination of the metallic molybdena dissolved entirely in the water. It appears, that here the blue oxyd had penetrated the rest of the mass, and prevented the whole from becoming oxydated to this degree, and that it had thereby itself become less soluble.

The residuum, dried, weighed twenty grains, and was of a dark grey colour inclining to a brown; which led me to believe that it was only a mixture of brown oxyd and metal. I put it again into the cup, and roasted it cautiously; and accordingly, as soon as I began to heat it, its colour passed into a brown inclining to blue, and it gradually assumed entirely the latter tinge. After having boiled it three different times with two ounces of water, and evaporated to one half, I obtained a blue solution. The residuum which remained still weighed fifteen grains, and was of a copper-brown, inclining to a blue. I put it for a moment aside, and undertook an experiment upon a larger quantity of metal, with a view to discover a more expeditious means of obtaining the blue oxyd.

Experiment 24. I reduced to as fine a powder as possible two hundred grains of metallic molybdena, and treated them as in the preceding experiment. An oxyd was formed of a copper-brown colour, which became blue as the action of the heat was continued. When it was almost of an indigo blue, with a tinge of grey, and began to burn in different places, I withdrew it from the fire, and put it into two ounces of water, boiling it till one half was evaporated. The solution was blue. The residuum was again treated three times in the same man-

ner.

ner. The last residuum had entirely lost the blue colour, and assumed that of copper. Having boiled it two more times, I still obtained a blue solution; an evident proof that mere boiling in water changed the brown oxyd into blue, and that consequently the latter was in a superior state of oxydation.

I now wished to try whether I could change the brown oxyd which remained into blue oxyd, by continued boiling in water. For this purpose, I put it with sixteen ounces of distilled water into a large vessel, and boiled it till the liquor was reduced to two ounces. The solution was blue, it is true; but not so much so as I had expected from so long continued an ebullition. I then examined whether the brown residuum might not be more easily changed into blue oxyd, if I merely wetted, and afterwards dried it, and this repeatedly. This I did ten times, and every time I poured an ounce of water upon the residuum, and boiled it for five minutes. The solution was always blue. Proceeding in this manner, I had at last only eleven grains of brown oxyd left.

This method of preparing the blue oxyd is very laborious. I was sensible of its defectiveness, and endeavoured in various ways to find out a better. I had found that, when we decompose a solution of molybdena in sulphuric acid by an alkaline sulphuret, and then add again a small quantity of sulphuric acid, the precipitate which had at first been formed is decomposed, and a blue solution produced. But I found no means of collecting the blue oxyd in its pure state; for, after having evaporated the solution of this oxyd, I could not separate from the residuum, on account of its solubility in water, either the sulphuric acid, or the alkaline sulphate which had been formed with the aid of the alkali of the sulphuret: a portion of the sulphur still remained in this residuum.

 The

The alkalies separated, indeed, a small quantity of oxyd when the solution was concentrated, but its solubility did not suffer what was upon the filtre to be washed; besides I remarked, that an excess of alkali caused the blue colour to lose, and that consequently it in all probability occasioned a greater oxydation.

I attempted, with a view to effect the desired separation, to avail myself of the fact observed by Scheele and other chemists; namely, that the molybdic acid, when dissolved in other acids, gives a blue colour. The muriatic acid appeared to me the fittest for my purpose, on account of its volatility. I dissolved two drachms of the brown oxyd obtained by calcining the molybdate of ammoniac, in moderately concentrated muriatic acid. The solution passed, during ebullition, from the brownish-yellow to the yellowish-green, and then into the deep blue. I evaporated to dryness, and I obtained a mass of an obscure blue, but which I could not entirely separate from the acid which adhered to it. When I attempted to wash it, it dissolved in part, and what passed through the filtre, as well as what remained upon it, contained muriatic acid. If I heated the blue mass still more strongly, it became grey, and lost with the muriatic acid its solubility in water. After several other trials, varied in different ways, and which proved unsuccessful, I was at last conducted to the object of my search by the consideration of a very simple fact, namely, that a solution of molybdic acid assumes a blue colour when it is in contact with most of the metals.

I conceived that the result might be the same with molybdena in the metallic state, and that this metal, by dividing the oxygen with the molybdic acids, might cause them to pass into the state of blue oxyd.

Experiment

Experiment 25. I therefore took twelve grains of metallic molybdena and twenty-four grains of molybdic acid, reduced the whole to very fine powder, and put it into seven ounces of water. At the end of ten minutes, the liquor, which was at rest, assumed a blue colour, which became more and more intense. After having boiled for half an hour, I found the solution much more concentrated than it had been in any of the preceding experiments. On boiling a second time, the whole of the molybdena and the whole of the acid disappeared, and were changed into blue oxyd, with the exception of two or three grains.

I now wished to try whether I could not obtain, in a still simpler and more economical manner, the blue oxyd, by substituting, in the place of the metallic molybdena, the brown oxyd obtained by the decomposition of the molybdate of ammoniac.

Experiment 26. A hundred grains of molybdic acid and eighty grains of brown oxyd were triturated together, and reduced to a very fine powder. I moistened this powder, and after some time I saw a brown colour appear; but it did this much more slowly than when the metallic molybdena had been employed: however, after having triturated this moist mass for a quarter of an hour, I obtained a very blue paste. I boiled four times; each time with four ounces of water; and the whole was dissolved except a few grains. The solutions were blue.

Several other trials convinced me that molybdena, in the metallic state, exercises a much greater action upon the molybdic acid, for converting it into blue oxyd, than the brown oxyd. I also found, that by triturating for a long time a mixture of molybdena in the metallic state and brown oxyde, and continually adding water in such

a manner

a manner as to keep the mixture of the consistence of a paste, the greater part of the mass may be converted into blue oxyd.

When the mixture was dry, I poured upon it extremely pure water, and there was disengaged, in the most sensible manner, an odour nearly resembling that of oil of rosemary, mixed with a faint smell of camphor. This phenomenon is a very extraordinary one; but should any one be inclined to doubt its reality, I appeal to the testimony of Messrs. Tromsdorff and Haberlé, who were with me when I made the experiment. Its cause may probably be discovered when larger quantities of matter shall be operated upon.

Experiment 27. I took all the solutions of the blue oxyd in pure water, resulting from the preceding experiments, poured them into a capsule of porcelain, and boiled them to the consistence of a syrup. During the boiling the liquor became much lighter coloured, and at last appeared of a deep steel grey. After cooling, it entirely resembled a concentrated solution of acetite of copper, inclining a little to a blue, or, in other words, it was of a deep blueish-green. No precipitate however had been formed. The addition of a small quantity of muriatic acid appeared to restore the original blue colour. This experiment evidently shewed, that the blue oxyd could pass into a higher degree of oxydation by the effect of mere boiling with water, and that it is necessary we should use all possible care to avoid this degree of heat when we wish to obtain the blue oxyd. Several other experiments, which it would be superfluous to detail in this place, have shewn that the following process is the best adapted for obtaining a pure and permanent blue oxyd.

Take

Take one part of metallic molybdena and two parts of pure molybdic acid (or three parts of brown oxyd and four of acid); triturate them together for a long time in a mortar of porcelain or glass; moisten the mixture with a small quantity of distilled water, either at first, or when the mixture is in the state of a fine powder, so as to bring it to the consistence of a paste: continue to triturate, applying a moderate heat, till the matter is very blue. Then add from eight to twelve parts of water, and boil for some minutes; after having let the liquor stand for some time, filtrate it; continue to triturate and wash the residuum till no more blue solution is obtained. Pour all the solutions into a capsule of porcelain, and evaporate them by a heat from 30° to 40° Reaum. The colour is not sensibly changed, and we obtain a residuum of the most beautiful blue, which is soluble in a very small quantity of water. Care must be taken not to perform the evaporation too slowly; for I think I have observed, that by an effect of the contact of the oxygen of the atmosphere, the blue oxyd passes gradually into the green, the yellow, and at last even into the white molybdic acid: at least I have remarked these phenomena, when there has been potash or ammoniac in the blue solution.

We may also prevent this accident in the most effectual manner, by leaving in contact with the solution which we evaporate, a small quantity of metallic molybdena or of brown oxyd, till the liquor has acquired the consistence of a syrup; by which means we render inert that portion of oxygen which might produce a higher degree of oxydation.

From the experiments upon the blue oxyd which have been recorded, we may deduce the following results;

1. Several

1. Several of the degrees of oxydation which we had already observed have been confirmed, and some others have been discovered. In the experiments which I have made upon the metallic molybdena, I have frequently remarked that its surface lost its brilliancy, and seemed to become covered with a *grey* matter.

This is certainly a commencement, a first degree, of oxydation; the *brown* oxyd is the next; it passes, as has already been shewn, by boiling, into the *blue*. The latter is produced, either by heating the metal, or by heating the brown oxyd obtained by the decomposition of the molybdate of ammoniac; and it appears that the substance produced by these two different operations ought to be considered as identically the same. After the blue oxyd, we have the *blueish-green*, which is produced by boiling the first, or leaving it exposed for some time to the contact of the air: the contact of metallic molybdena, as well as the action of pure ammoniac, restores it to the state of blue oxyd. Finally, the blueish-green oxyd passes into the *yellow* and then into the *white*, which is the molybdic acid. The transmutation of the blue oxyd into the two last is greatly promoted by the presence of an alkali.

2. The white molybdic acid placed in contact with the brown oxyd, or with the metal, divides its oxygen with them, and thus passes into the state of blue oxyd. The blue colour which the molybdic acid acquires by the addition of metallic solutions, a phenomenon which has been remarked by Scheele, Heyer, and Ilsemann, is the effect of a similar disoxygenation. Other disoxygenating circumstances may also cause the molybdic acid to pass into the state of blue oxyd; such, for example, as the application of a current of ammoniacal gas to this acid.

After

After having discovered these different degrees of oxydation, it would be desirable to determine the proportion which the oxygen bears to the metal in each of them. I shall undertake this investigation, as well as some other inquiries, when I shall have been able to procure a sufficient quantity of ore of molybdena. These inquiries will have for their principal objects the blue and the brown oxyds; for it is these two whose existence is the most permanent, and which can be the most easily produced in large quantity and entirely homogeneous; but what renders them most important is, that they frequently present themselves in the different operations which we perform upon molybdena. I shall content myself with specifying in this place some of the principal properties of the blue oxyd. 1. It comports itself entirely after the manner of the acids; it turns blue paper red even more rapidly and powerfully than the *white* acid: it produces a brisk effervescence in combining with the alkaline carbonates, and yields with them a blue solution. We here see a base, containing a certain quantity of oxygen, manifest a stronger acidity, than when it contains a larger proportion of the acidifying principle. This is an anomalous fact of a very remarkable kind.. 2. This acidity still remains when the blue oxyd has passed into the state of blueish-green oxyd (which latter is restored to its former state by the addition of an alkaline carbonate). Its preparation alone indicates its solubility in water, but I have not yet ascertained the proportion which this fluid is capable of dissolving.

Experiment 28. We have already seen in what manner metallic molybdena comports itself when heated in contact with the air. Some phenomena which presented themselves when I determined the specific gravities, led me to examine what would take place on leaving it in

contact with water at the ordinary temperature. I accordingly took thirty grains of powder of molybdena, which I put into a capsule of porcelain, wetted them with water, and left to slow evaporation. Having poured a fresh quantity of water upon them, the latter afterwards assumed a blue colour; and by repeating this operation several times, I at length converted the whole of the metal into blue oxyd. Here were not produced those different degrees of intermediate oxydation which had been observed in the other experiments. The brown oxyd, treated in the same manner, gave a similar result.

VIII. *Of the manner in which Molybdena comports itself with regard to several of the Acids.*

1. *Sulphuric Acid.*

Experiment 29. I put ten grains of pulverized molybdena into half a drachm of sulphuric acid, of 1,86 sp. weight, and left them in it for twenty-four hours, in an ordinary temperature. The acid did not produce the smallest effect upon the metal. On the application of a moderate heat, a large quantity of sulphurous acid was evolved, the liquor assumed a yellowish-brown colour, and the consistence of a syrup. I diluted with four times the quantity of water, and the liquor passed into a brownish-yellow: after standing for some time, it deposited a small quantity of molybdena which had not been dissolved. The liquor having remained for some hours in contact with the metal, it gradually passed into a green, and afterwards into a blue; but, what is the most remarkable circumstance, a portion of the blue oxyd was precipitated in the form of a very fine powder. The cause of this phenomenon remains to be investigated.

From

From this experiment it appears, that the molybdena was changed by the action of the sulphuric acid into a yellow oxyd, containing more oxygen than the green and the blue, and which was converted into green oxyd by an effect of the disoxydation produced by the contact of the metallic molybdena.

2. *Nitric Acid.*

Experiment 30. We have already had occasion, in treating of the oxygenation of molybdena, to say something respecting the action of the nitric acid upon this metal. The experiments which I am about to relate will form the sequel to what has there been said. I put ten grains of pulverized molybdena into two drachms of nitric acid, diluted with an equal quantity of water. At the end of a quarter of an hour a slight evolution of nitrous gas took place, and there was formed a solution of a pale red colour. In order to accelerate the action of the acid, I employed a mild heat: the molybdena soon disappeared, and the liquor assumed a yellowish-brown colour, with a cast of red. I twice added ten grains of molybdena, and when I had added the last ten grains, the liquor, which before was limpid, became turbid, and of a flesh-red colour; which, combined with a slight evolution of nitrous gas, led me to conclude, that the acid was completely saturated. After standing for some time, blue oxyd was formed at the bottom of the vessel, where there still remained a small quantity of undissolved molybdena; a phænomenon similar to that which had been remarked in the solution by the sulphuric acid. Twenty-four hours afterwards, the matter which rendered the liquor turbid was separated, and it comported itself entirely as molybdic acid.

A solution of molybdena in nitric acid, made without the application of heat, became after some hours entirely limpid, and of a yellowish-brown colour inclining to red: it had a slightly acid taste, and left a bitter and somewhat metallic after-flavour. A portion having been evaporated by a gentle heat in a capsule of porcelain, left a pulverulent residuum of a dingy reddish-yellow colour, which being mixed and stirred with a small quantity of water, dissolved in it entirely, with the exception of a small portion which was molybdic acid. The solution was of a yellow colour, inclining to red. Being put to digest with metallic molybdena, it became blue.

Twenty grains of pulverized molybdena having been put into a drachm of fuming nitric acid, a very brisk effervescence took place, accompanied with an evolution of red vapours, and the mixture concreted into a mass of a light brownish-red colour. On pouring upon it another drachm of the same acid, and heating moderately, white molybdic acid was very readily produced.

Experiment 31. The reddish solutions obtained by the preceding experiments, were filtered, after which ammoniac was cautiously added, which produced a flaky precipitate of a brownish-red colour, which, when washed and dried, gave a powder of a lighter colour, interspersed with white and shining crystalline particles. A portion of this powder was put into a small quantity of water, and stirred in a middling temperature: it dissolved with the exception of some small white crystals. The crystals, however, were not molybdic acid, for they were much more soluble, and had a much stronger acerb taste. The solution of the brown powder was of a wine-yellow colour, inclining to the red. The water with which this powder was washed after its precipitation, had a much deeper colour, because the precipitate was more soluble after

having

having been wetted. I added ammoniac (or potash) to the solution, and there was gradually separated from it, once more, a precipitate of a brown-red colour. This precipitate was treated with a solution of alkaline carbonate: it was not attacked by it, but the white crystals were dissolved with effervescence. Further experiments will be requisite, in order to determine the nature of the products formed in this operation. I shall here content myself with observing, that the brown precipitate must not be taken for the brown oxyd obtained by the decomposition of the ammoniacal molybdate; for this oxyd appears to be insoluble in water; besides which, the precipitate does not give blue oxyde with the molybdic acid, but only with the molybdena in the metallic state, which indicates a higher degree of oxygenation than that which belongs to the blue oxyd.

3. *Muriatic Acid.*

Experiment 32. Ten grains of pulverized molybdena were put into a drachm of muriatic acid of 1,135 specific gravity, and left in it for twenty-four hours. The acid exerted no action at all upon the metal; it remained in the same state; even after it had been boiled to dryness, a second drachm of acid was added, and boiled for some minutes, without producing any effect.

This fact appeared to me inconsistent with the property which I had observed in metallic molybdena, of being converted into blue oxyd after having been simply impregnated with water. I therefore resolved to employ sulphuric acid * *diluted with water.* But the metal was in no wise attacked, either by a mixture of equal parts of water

* The author seems to have written here, from inattention, *sulphuric acid* instead of *muriatic acid.*

water and of acid, or by one of two and of three parts of water to one of acid; nor even when the mixture was subjected to ebullition, and to long continued digestion. Hence it appears that when the powder of molybdena was simply wetted, the oxydation was produced, not by the water, but by the oxygen of the atmosphere, the water serving only to conduct the oxygen, and to dissolve the oxyd that was formed, so that in this manner the metal continually presented a new surface to the action of the air.

4. *Oxymuriatic Acid.*

Experiment 33. I put ten grains of metallic molybdena into three ounces of water saturated with vapours of oxymuriatic acid, and having slightly stirred the mixture, I obtained an inodorous blue solution. But the greater part of the metal was not dissolved; neither was it by six ounces of acid. The liquor, having been filtrated, was limpid and of a beautiful blue colour; on adding to it liquid oxymuriatic acid, the solution assumed the appearance of clear water. Molybdena in the metallic state being added, the blue colour was restored.

5. *Arseniac Acid.*

Experiment 34. Ten grains of molybdena were put into a drachm of liquid arseniac acid, containing one-half dry acid, and inclosed for twenty-four hours in a well-closed flask. At the expiration of this time, a thin stratum of the liquor, about half a line in thickness, appeared of a yellow-brown colour. The liquor was boiled and evaporated to dryness. The residuum was mixed with half an ounce of water, and after slight agitation a beautiful blue solution was obtained, and it appeared that only a small portion of the metal had remained unchanged. Thus the metal had here been oxydated at the cost of the arseniac acid, and converted into blue oxyd.

6. *Phos-*

6. *Phosphoric Acid.*

Experiment 35. I put ten grains of molybdena, half a drachm of phosphoric acid, and a drachm of water into a flask, which I corked well, and let the whole stand for twenty-four hours. No action took place. I then boiled to dryness. When the residuum was almost dry, it exhaled a vapour which had a little of the smell of phosphorus, and was accompanied with an odour nearly resembling that which an alkaline lye exhales when one concentrates it. The flame of burning paper held over it assumed a greenish yellow tinge. The residuum was heated to redness, but there was no stronger odour exhaled that could authorize the supposition of an action of the phosphoric acid upon the molybdena; on the contrary, when the mass, after cooling, was mixed with half an ounce of water, the greater part of the metal remained at the bottom, without having undergone any alteration. The liquor above was of a yellowish brown colour, it had a powerfully acid taste, and left a metallic twang in the mouth. A like quantity of water was repeatedly evaporated upon the metal; but not the slightest change was remarked, nor was there any blue oxyd formed. A small quantity of this solution was evaporated to dryness, and there remained a greyish-blue matter, which, being dissolved anew, resumed, to my great astonishment, a yellowish-brown colour. Ammoniac, added to the solution, gave it an obscure colour, without producing any precipitate: it was not till after twenty-four hours that some brown flakes were separated.

7. *Boracic Acid.*

Experiment 36. Having treated molybdena in the same manner with boracic acid, I found the liquor, after some hours, of a slight blueish tinge, which did not afterwards increase;

increase; not even when I evaporated and dissolved anew; whence it appears, that the boracic acid exerts no action upon molybdena, and is not the cause of the slight blue colour observed.

I obtained the same result when I employed the *succinic*, the *tartarous*, and the *citric*, acids; only I observed, in operating with the *succinic*, that the liquor became green during the evaporation. The *acetic* acid produced no action when cold; when it was boiled, and the liquor reduced to about one half, it assumed a brownish yellow colour. Ammoniac scarcely rendered the solution turbid.

From what has just been stated it follows: 1, That whenever molybdena is dissolved by the acids, it is oxydated at their expence, and that consequently it can be dissolved only by those acids which, like the nitric, the sulphuric, the oxymuriatic, the phosphoric and the arseniac, are susceptible of different degrees of oxydation, and capable of yielding their oxygen either at the ordinary or at a more elevated temperature; 2, that molybdena may be brought by the action of the acids into the state of blue oxyd, and sometimes into that of brown oxyd (the nature of the latter remains still to be ascertained): it appears that there is none but the phosphoric acid that produces a different state; 3, that these solutions can hardly be considered as salts, on account of the acid nature of the oxyd of molybdena.

IX. *Action of Potash upon the natural Sulphuret of Molybdena.*

Experiment 37. I poured upon fifty grains of pure sulphuret of molybdena a ley containing two hundred grains of pure caustic alkali, and evaporated to dryness: I mixed the residuum with water, and evaporated again: this I repeated several times, and finally, the part which

had

had remained undissolved I separated by the filtre, washed and dried. The loss was found to amount scarcely to four grains; what remained had retained the appearance which it had at first. I poured upon it sulphuric acid diluted with water, and not hydrothionic acid (sulphurated hydrogene) was evolved: the filtrated liquor had a strong taste of sulphurous acid; sulphuric acid diluted with water disengaged from it a large quantity of hydrothionic acid; and its colour, which was at first a pale brownish-yellow, passed into a reddish brown, and after some minutes there was formed a precipitate of a beautiful brownish-red, which passed gradually into a brown, and from that to a yellowish-brown: the liquor became of a pale reddish-brown. The precipitate, when dried, was of a chocolate colour, and weighed three and a half grains: it appeared to be a mere hydrothionate of molybdena, for, heated with muriatic acid, it exhaled a small quantity of hydrothionic acid gas; and heated to redness in a crucible, it did not give the blue flame of sulphur, but merely a smell of sulphurous acid. Decomposed by nitric acid, it gave sulphuric acid, which was rendered sensible by means of barytes.

Experiment 38. I put twenty-five grains of sulphuret of molybdena into a ley containing a hundred grains of caustic alkali; I evaporated and heated to redness for a quarter of an hour; as soon as the alkaline mass began to run, the alkali acted so strongly upon the molybdena, that the latter seemed entirely fused in the first; the whole had assumed a cherry-red colour, which passed into a deep crimson. The water which was poured upon the matter assumed a deep green colour, which disappeared at the expiration of some hours by mere exposure to the air, and was changed into a blackish-grey. I washed and dried, and the residuum which I obtained was of a light grey, and weighed twenty grains. We shall soon see of what nature it was.

Sulphuric acid and muriatic acid diluted with water, and put in excess into the solution which had passed through the filtre, disengaged from it hydrothionic acid, and occasioned a precipitate similar to that of the preceding experiment. A portion of the molybdena formed with the free acid a blue solution above the precipitate. The nitric acid gave rise to a similar precipitate; but the blue liquor which was above it became greenish, and afterwards of a reddish yellow, in consequence of the progressive oxydation.

The experiments which I have here recorded, indicate that the alkali (the potash) exerts but very little action upon the molybdena in the dry way, and still less in the humid way. Imagining that if the quantity of sulphur were augmented, the action might become more considerable, I made the following experiments.

Experiment 39. I took ten grains of pulverized molybdena, which I put into half an ounce of alkaline ley, in which I had dissolved twenty grains of sulphur. I boiled and evaporated twice almost to dryness. The matter was like in the 38th Experiment, of a cherry-red colour at the sides of the capsule: the solution, after water had been added, was of a beautiful deep green. Otherwise the molybdena did not appear to have been sensibly attacked; forty grains of sulphur were added, and the process before indicated was three times repeated. The molybdena underwent but little alteration, with a loss of only two grains. The solution having been decomposed by the sulphuric acid, gave only a precipitate of a greyish-blue colour, of an appearance perfectly resembling that of what is termed *milk of sulphur*, and containing some flakes of a yellowish-grey colour.

Experiment 40. I then took two drachms of alkaline ley, thirty grains of sulphur, and ten grains of molybdena. I put the whole into a Hessian crucible, evaporated to dryness, and heated to redness for a quarter of an hour.

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I mixed the mass with eight ounces of water, and filtrated; the undissolved residuum weighed three grains. The solution was of a beautiful yellowish red: sulphuric acid produced in it a precipitate of a blackish-brown colour, which suffered no alteration from an excess of the same acid; the liquor exhibited no appearance of blue colour; the precipitate, after having been separated, washed and dried, was of a brownish black, and weighed forty-five grains.

It underwent no alteration when it was boiled with sulphuric acid and afterwards with muriatic; but when nitric acid was added to the latter, and the boiling repeated, it was decomposed and dissolved, with the exception of a small quantity of sulphur. A solution of barytes indicated the presence of the sulphuric acid. Five grains of the precipitate having been heated to redness in a small glass, let about two grains of sulphur escape. The residuum was quickly oxydated by the nitric acid; but in this solution there was still a small quantity of sulphuric acid, which proves that the action of the fire had not separated the whole of the sulphur. It follows from what has just been stated, that the precipitate was composed of molybdena in the metallic state, or near to that state, of hydrothionate of sulphur, and of a small excess of sulphur; whereas the precipitates of Experiment 36 were composed of oxydated molybdena, merely combined with the hydrothionic acid, or at most with a small quantity of sulphur. This experiment, when repeated upon four times the quantity of molybdena, and the roasting continued for a quarter of an hour longer, gave the same result.

X. *Action of the Hydrothionates of Alkaline Sulphurets, and of the pure Hydrothionic Acid upon the Molybdic Acid.*

Experiment 41. I dissolved a quantity of molybdate of ammoniac in twenty times its weight of water, and

added sulphuric acid till the precipitate that had formed was entirely redissolved: then I poured into it hydrothionate of ammoniacal sulphuret, and there was produced a precipitate of a reddish brown colour, which was more or less considerable, and had above it a liquor more or less blue, in proportion as the quantity of sulphuric acid and of water employed for the solution was more or less considerable. I found also, that when only a small quantity of hydrothionate of ammoniacal sulphuret was added to the molybdate of ammoniac, the sulphuric acid produced no precipitate; but merely turned the solution blue; whereas a precipitation took place when a larger quantity of hydrothionate of ammoniacal sulphuret was used: thus, in one of the cases, the whole of the hydrothionate of sulphur was employed for the disoxydation of the molybdic acid.

Experiment 42. Five grains of sublimed molybdic acid, dissolved in ten drops of concentrated sulphuric acid, were put into five ounces of water: the hydrothionate of ammoniacal sulphuret produced a precipitate of a chocolate colour, which was almost black when it was dried: an excess of acid did not decompose it, nor produce any blue colour; it therefore resembled the natural sulphuret of molybdena.

Experiment 43. A quantity of molybdate of ammoniac was dissolved in twelve times its weight of water: sulphuric acid was added till it was in excess; then solution of sulphuret of potash was poured to it; and there was produced a precipitate of a light reddish-brown, the liquor becoming blue. The sulphuric acid having been added only to saturation to a solution of molybdate of ammoniac, the hydrothionate of sulphuret of potash gave a precipitate of a flesh-red colour, inclining to a copper-colour. In a solution to which no sulphuric acid had been

been added, the hydrothionate produced no precipitate, the liquor only became a little milky, as might have been expected from the property which we have already remarked in the sulphuret of potash, of dissolving the molybdena. When acid was afterwards added, it again produced a precipitate of a reddish brown colour. All these precipitates were decomposed by excess of acid; a blue solution was formed, and there remained at the bottom only sulphur of a brownish grey colour, and containing a small quantity of molybdena.

Experiment 44. I joined two flasks together, as in Woulfe's apparatus; into the one, which served as the receiver, I put a solution of a drachm of molybdic acid in eight ounces of water, and into the other an ounce of sulphuret of lime and eight ounces of water, from which sulphurated hydrogen gas was evolved. From the first moment that this gas passed through the solution, the latter assumed a reddish brown colour, which became more and more intense, the liquor still preserving its limpidity. It had a strong smell of sulphurated hydrogen. I took a small quantity of it, and having added muriatic acid to it, a blackish precipitate was formed. At the end of twenty-four hours, the great solution appeared a little turbid; having afterwards been left for twelve hours exposed to the air, it became quite turbid, opaque, and of a dirt-colour. When heated to ebullition, it resumed its limpidity and its colour, only the latter inclined a little more to a yellow. The froth which was formed during the ebullition was of a beautiful reddish-yellow, like the saffron dye. When I evaporated, by a moderate heat, to dryness, a smell of sulphurated hydrogen was continually exhaled, and towards the end a large quantity of ammoniac was evolved.

The residuum, which weighed fifty-five grains, was of a light chocolate-brown colour. It exhibited the follow-

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ing properties. 1. Ten grains having been exposed to a moderate heat, a considerable quantity of ammoniac was evolved, accompanied with a smell of sulphurated hydrogen; this smell was alone sensible when the heat was augmented; at last sulphurous acid was evolved, and the matter assumed a blueish-black colour: it weighed eight grains, and was insoluble in water and in acid moderately concentrated, under a middling temperature. Thrown into an ignited crucible, it was immediately heated to redness; vapours of sulphurous acid were evolved, and it melted. This was molybdic acid. 2. Ten grains of residuum, put into a drachm of muriatic acid and heated to ebullition, exhaled but little sulphurated hydrogen: a solution was formed, of a brownish-yellow colour, which, being diluted with water, assumed at first a blueish-green colour and afterwards one entirely green. A like quantity of the matter, having been previously agitated in water, and then put into muriatic acid, evolved a considerable quantity of sulphurated hydrogen, and a blue solution was produced, which soon assumed a green cast, and deposited a blue precipitate, which was insoluble in water, and which I had already had occasion to remark in several experiments. As its external appearance greatly resembles that of the blue oxyd of molybdena, from which however it differs, as not being soluble in water like this oxyd; its nature ought to be the subject of a new examination. 3. Five grains of the dry residuum were agitated in half an ounce of cold water: no effect was produced. Having been put to boil for a quarter of an hour, they were dissolved all except two grains, which were of a fine reddish-yellow colour. The solution had the same colour as the preceding ones; it exhaled a strong smell of sulphurated hydrogen; sulphuric acid increased this smell, and rendered the solution first blue and afterwards green. It appears to result from

from all this, that the residuum is a triple combination of hydrothionic acid (sulphurated hydrogen), ammoniac, and molybdena: otherwise it comports itself with regard to the acids like the precipitates obtained in Experiments 38, 41, 43. Roasting (to redness) renders it similar to the natural sulphuret of molybdena; from which however it still appears to differ by a small content of sulphurated hydrogen: it is much more speedily converted into acid by the action of fire than the sulphuret of molybdena.

Experiment 45. I put into the same apparatus as that used in the preceding experiment, and subjected to the same treatment, ten grains of very pure molybdic acid, which had been fused, then reduced to powder, and boiled in ten ounces of water, which had dissolved but the smaller part of it. As soon as the sulphurated hydrogen gas began to pass, the liquor became brown; its colour became more and more dark, and the greater part of the molybdic acid which floated in the solution was dissolved: there remained at the bottom only some flakes of a brownish-black hue. The liquor at last assumed the same colour as in the preceding experiment; it had a strong smell and taste of sulphurated hydrogene. At the end of twenty-four hours it became turbid, and deposited a considerable quantity of a yellowish-brown powder, which was separated and dried; when it assumed a brownish-black colour. The filtrated liquor was of a yellowish-brown; when it was boiled, sulphurated hydrogene was evolved from it, and a larger quantity of powder was precipitated: the smell of sulphurated hydrogen had become very weak; it became much stronger when some drops of muriatic acid were added, which produced a blue colour. The precipitated powder, when put into muriatic acid, and exposed to a moderate heat, comported itself like the residuum of the preceding experiment; but ebullition at last produced a solution of a brownish-yellow colour. A small

small quantity of this powder being thrown into a red-hot crucible, immediately burned with a sulphureous flame, which soon disappeared. This experiment shews that the pure molybdic acid is also capable of combining with the hydrothionic acid; but this combination is not so constant as that of the preceding experiment, in which there is also ammoniac. It proves the variations which the less limited disoxygenating action of the hydrothionic acid must produce: it also passes, by the mere effect of desiccation, into the state to which the combination of the preceding experiment cannot be brought, without the application of a much more intense heat; and it forms, by the oxydation of a portion of the hydrogene, a hydrothionate of sulphuret of molybdena, which gives in roasting a brisk sulphureous flame (which the natural sulphuret of molybdena does not), and which is converted into molybdic acid.

It still remained for me to examine the action of the hydrothionic acid upon molybdena under the same relation as in Experiment 41.

Experiment 46. I caused sulphurated hydrogen to pass, in the manner already specified, through a solution of a drachm of molybdate of ammoniac in four ounces of water, and which had been decomposed and redissolved by three drachms of rectified sulphuric acid. At the end of two or three minutes the solution, which before had the appearance of water, assumed a blue colour; five minutes after, there was deposited upon the wet sides of the vessel, and upon the surface, a matter of a light chocolate-brown, which disappeared in the course of a few minutes. The beautiful blue colour of the solution passed into a black, and a precipitate was produced of the same colour. The liquor having been filtrated, and placed over the fire, reassumed a fine blue, by the effect of ebullition. The water with which the precipitate was

repeatedly

repeatedly washed, was likewise blue, but its colour was less intense. The precipitate having been dried, was of a blueish black. It gave the following results. 1. Boiled in muriatic acid, moderately concentrated, it produced a solution of a brownish-yellow. 2. Thrown into a crucible heated to an obscure redness, it burnt with a fine blue flame, which very soon ceased in a crucible heated to a bright redness; no more flame was produced, but an evolution of a very considerable quantity of sulphurous acid. The residuum which was left when the combustion was accompanied with flame, was of a blackish-brown colour; it was not soluble in water, and an augmentation of heat reduced it into molybdic acid: when agitated in water, it imparted to it, after some time, a slight blue tinge. The residuum, having been separated by the filtre, had lost its brown colour, and appeared almost entirely black. These experiments shew that the molybdic acid was at first disoxygenated, and that afterwards it entered into combination in the brownish-black precipitate, which seems to contain a small quantity of blue oxyd (which appears peculiar to this case, and merits examination), but which, in other respects, comports itself as in Experiment 45.

From all the experiments which have been recorded in this tenth Section, we may deduce the following inferences. 1. That potash exerts scarcely any action upon the sulphuret of molybdena by the wet process, that its action is more considerable by the dry process, and that when afterwards dissolved in water, more or less combination takes place between the sulphurated hydrogen and the sulphur. 2, That the sulphuret of potash comports itself in the same manner. The acids precipitate from the combinations produced by the dry process, a matter which is a sulphuret of molybdena, containing a

small quantity of sulphurated hydrogen, and which comports itself with respect to the acids nearly in the same manner as the natural molybdena. 3, The hydrogenated alkaline sulphurets precipitate from the solution of molybdic acid, a matter of a colour resembling that of chocolate, which imparts a blue colour to the acids in which it dissolves, and which appears to distinguish itself from the preceding matter, by the oxydation of the molybdena, by a more considerable content of sulphurated hydrogen and a less of sulphur. Thus we have two combinations of this species, and the latter appears capable, under certain circumstances, of being converted into the former. 4, Pure sulphurated hydrogen gas combines equally with molybdena, presenting phenomena which indicate a disoxygenation, and it forms products similar to those resulting from their combinations. This gas, conducted through a solution of molybdate of ammoniac, gives rise to a triple compound, which is soluble in water, which is decomposed by heat, and becomes similar to the natural sulphate of molybdena.

I here conclude the account of my experiments on molybdena. I readily acknowledge that they do not exhibit a complete investigation of the subject; but I flatter myself that they may still afford several results of importance to the system of our chemical knowledge. It also was necessary, that these experiments should once be made; and I can confidently assert that I have executed them with all possible care and attention, so that their accuracy may be relied upon. Additional experiments will be requisite to complete this inquiry; these I purpose to undertake as soon as I shall have provided myself with a sufficient quantity of matter, and have leisure to attend to them.

Observations

Observations on Mr. SCHMALCALDER's *Patent for a Machine for tracing and cutting out Profiles, by Mr.* JOHN ISAAC HAWKINS. *Communicated to the Editors by the Author.*

GENTLEMEN,

IN the 58th number of the new series of your valuable work I observe a specification of Mr. Schmalcalder's patent for a machine for tracing and cutting out profiles, &c.

Having myself obtained a patent in the year 1803 for the same purposes, the specification of which was published in your 23d number, vol. IV. second series, I think it a duty I owe to the public to shew that Mr. Schmalcalder has not the least claim whatever to a patent, that they may not risk a prosecution by using machines made under that pretence by him.

In doing this I am not actuated by interest, having sold my patent-right to Mr. Farthing, No. 12, Cheapside; I shall never have either profit or loss by it; neither am I influenced by personal motives, for I respect Mr. Schmalcalder as an ingenious man, and shall rejoice to see him profit by his own inventions and industry; and I have written this without Mr. Farthing's knowledge, a sense of justice alone guiding my pen.

All that is valuable of Mr. Schmalcalder's alledged invention is described in my specification, and the parts of minor consequence are easily inferred from the same, except the cutter for cutting out profiles; which cutter was invented by me soon after the date of my patent, and a machine made on purpose to use it in, upwards of two years since, for Mr. Farthing, at whose profile rooms it was exhibited and used. A drawing of this machine was shewn to Mr. Schmalcalder several months before he took out his patent.

 His

His rod (*a*, Figs. 1 and 2) is one limb of my perspective parallel ruler (Fig. 21, *e e e e*), and (Fig. 24) with the marking point fixed in the end beyond the centre of motion, instead of being put in another piece, working parallel to it on the same side as the tracer, and with a ball and socket instead of the bar (*g*); both of which ideas I communicated to the person who described them to Mr. Schmalcalder; but I considered them only as variations which might be made, and not as improvements, the marking beyond the centre requiring greater strength of the rod to prevent vibration, and the ball and socket having more friction than the plan contained in my specification.

From the imperfect description Mr. Schmalcalder has given of his tracer, I should suppose he intends a fine steel cylinder, with a strong part to fix in the rod. But a cylinder will not answer the purpose of taking profiles; for if it be strong enough to keep them from bending on a slight touch, its thickness will take off materially from the required accuracy; so much so, that in tracing very thin lips, with the mouth closed, no resemblance will be obtained. I speak this from experience, having used a similar tracer before I thought of that described in Figs. 13 and 15 of my drawings. Mr. Schmalcalder will therefore be compelled to borrow my tracer before he can use the machine at all. But whether he uses my tracer, or one of any other form, I conceive he infringes upon my patent; because mine was the first publication of a method of taking likenesses by passing over the features.

His method of holding the paper, &c. is exactly the same as mine (Fig. 20), the description of which is quite explicit, although your engraver has by some accident omitted the letters (*c d* and *e*) inserted in my original drawing.

That

That Mr. Schmalcalder had studied my specification before he drew up his, will appear by comparing a few passages from each.

Hawkins, 1803.	Schmalcalder, 1806.
Repertory, vol. IV. p. 337.	Repertory, vol. X. p. 242.
"they (the frames) are made of two plates of brass hinged together, between which the paper is put. In the plate nearest to the point is an aperture large enough for the likeness to be marked through it on the paper. At the opposite end of the plates is a button, to keep them tight together."	"a brass frame formed of two flat pieces of brass, joined together at the end by hinges, and having on the other end two buttons, to fasten the paper between. In the uppermost of this plate an opening is made to allow the point to mark upon the paper."
Page 328.	Page 243.
"The essential principle in the construction of the tracer above mentioned is, that it has a rotation on its axis, and that the tracing edge be in a line with that axis."	"In turning the rod round in the sockets, the tracer and point in the two ends of the rod must remain in the centre."

Mr. Schmalcalder errs much in supposing a correct copy of a picture hung upon a swinging frame could be obtained on a plate of copper, or any thing else, attached to another swinging frame at the opposite end; for the angle made by the rod with the plane of the picture at the top, would be so different from the angle made at the bottom, that one half of the copy would be lengthened in its proportions and the other half shortened, the width

width being in right proportion. I am now supposing the picture to be swung with its plane at right angles to the rod, when the rod is in the centre; but if it be so situated as to make equal angles at the top and bottom, the rod will not be at right angles with the centre: in either case the copy will be distorted, and this distortion would be absolutely intolerable if a picture of eight feet square should be copied by a rod of eight feet long, as Mr. Schmalcalder purposes.

Yours, &c.

City Road, April 10, 1807. JOHN I. HAWKINS.

List of Patents for Inventions, &c.

(Continued from Page 400.)

ARCHIBALD THOMSON, of the parish of St. John, in the city of Westminster, and county of Middlesex, Engineer; for certain improvements (by the application of known principles) upon certain parts of mill-spinning for spinning wool or cotton. Dated April 2, 1807.

JAMES PEACHE, of Cuper's-bridge, Lambeth, in the county of Surrey, Barge-builder; for a floating hollow buoy, on a new construction, for supporting mooring chains, cables, ropes, &c. Dated April 8, 1807.

WILLIAM CHAPMAN, of the town and county of Newcastle-upon-Tyne, Civil Engineer; for a method or methods of reducing the wear, and prolonging the duration of ropes used in drawing coals or other minerals from pits or shafts of mines. Dated April 8, 1807.

SAMUEL WILLIAMS, of Finsbury-square, in the city of London, Merchant; for new and improved machines and machinery for spinning wool, cotton, hemp, and other filamentous substances. Cmmunicated to him by a foreigner residing abroad. Dated April 8, 1807.

RICHARD

Richard Francis Hawkins, of the parish of St. Ann, Limehouse, in the county of Middlesex, Gentleman; for certain improvements to all kinds of gun and cannonade carriages, so as to facilitate the working or using, securing, and housing thereof, particularly adapted to ships. Dated April 8, 1807.

William Southwell, of the city of Dublin, Musical Instrument-maker; for certain improvements upon a piano-forte, which is so constructed as to prevent the possibility of its being so frequently out of tune, as piano-fortes now generally are, which he denominates "*A Cabinet Piano-forte.*" Dated April 8, 1807.

William Chapman, of the town and county of Newcastle-upon-Tyne, Civil Engineer; for a method or methods of putting coals on board of ships, lighters, and other vessels, so as to prevent a great portion of the breakage of the coals which takes place in the usual method of shipping them by spouts. Dated April 11, 1807.

Thomas Paty, of St. Thomas's Watering, Kent-road, in the parish of St. Giles, Camberwell, in the county of Surrey, Manufacturer; for a method of dying, spinning, weaving, and manufacturing of East-India sun-hemp into carpets and carpet rug-matts, which will be more durable and less expensive than any now in use.
Dated April 11, 1807.

Alexander John Forsyth, clerk of Belhelvie, Aberdeenshire, in Scotland; for a method of discharging or giving fire to artillery and all other fire-arms, chambers, cavities, and places, in which gunpowder or other combustible matter is or may be put for the purpose of explosion. Dated April 11, 1807.

Anthony Francis Berte, of the parish of St. Dunstan in the West, in the city of London, Merchant; for certain improvements in casting printers types and sorts, and

Cooke,

K Knight,

K

P *Paint*,

P

Q

R

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V *Vanherman,*

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